INSTITUTS SCIENTIFIQUES DE BUITENZORG
„'S LANDS PLANTENTUIN".

TREUBIA

RECUEIL DE TRAVAUX ZOOLOGIQUES, HYDROBIOLOGIQUES ET OCÉANOGRAPHIQUES

RÉDIGÉ PAR

Prof. Dr. W. M. DOCTERS VAN LEEUWEN,
Directeur du Jardin Botanique
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Dr. K. W. DAMMERMAN,
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SOMMAIRE.

HERPETOLOGISCHE NOTIZEN [1])

Von

Dr. FELIX KOPSTEIN.

Bandoeng, Java.

IV. Fordonia leucobalia Schlegel und Cerberus rhynchops Schneider.

Im Februar 1930 fand ich nahe bei Cheribon, an Javas Nordküste, ein Gebiet, in welchem *Fordonia leucobalia* und *Cerberus rhynchops* in grossen Mengen nebeneinander vorkommt. Der Fundort liegt unmittelbar an der Küste, innerhalb der Gezeitenzone und steht bei hohem Stande der Flut unter Wasser. Das Terrain wird von künstlichen Abwässerungsgräben durchzogen, welche ± 3½ m breit und ± 1 m tief sind. Diese Kanäle werden von zahlreichen *Cerberus rhynchops* bewohnt. Die Schlangen kommen hier so häufig vor, dass man besonders in der Abenddämmerung damit rechnen kann, alle 5—10 m einer zu begegnen. Nur selten sah ich *Cerberus* ausserhalb dieser Gräben in den Tümpeln, während *Fordonia leucobalia* ihrerseits nur in dem zwischen den Kanälen gelegenen Schlammeer lebt und niemals in den Gräben selbst.

Fordonia leucobalia.

Tagsüber hält sich *Fordonia* hier in den von Krabben gegrabenen Erdlöchern auf. Abends, vor Einbruch der Dämmerung, sieht man sie zahlreich in den Schlammröhren liegen, so dass nur ihr Kopf herausschaut. Wenn man sich ihr ruhig nähert, dann lässt sie sich sogar berühren, ohne zu flüchten. Bei hastigen Bewegungen jedoch zieht sie sich sofort in ihren Tunnel zurück. Auch wenn man ihr ausserhalb dieser Behausung begegnet, fällt ihre geringe Scheu gleich ins Auge. Sie fürchtet den Menschen scheinbar nicht, lässt sich aufheben und wieder zurücklegen, ohne zu fliehen. Nur wenn man sie erschreckt, verkriecht sie sich eilends in einer der zahllosen Krabbenhöhlen, von wo man sie kaum wieder ausgraben kann, da sich unter der von der Sonne oberflächlich getrockneten Erdkruste ein weicher Schlamm ausdehnt, in welchem sie sich gut verbergen.

Bei hoher Flut steht das Land hier weit und breit unter Wasser; doch tritt dies nur zeitweise ein. Im Februar lag die ganze Küste weithin mit einer niedrigen Strandflora bedeckt da; aber doch sank man auch damals überall mindestens knöcheltief in den Schlamm ein. 3 Monate später stand alles unter Wasser und trat die Flut nur ab und zu für ein paar Stunden zurück. Dann aber war *Fordonia* gleich wieder in den Krabbenhöhlen zu finden.

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[1]) Cfr. Treubia Vol. X, p. 467; Vol. XI, p. 301; Vol. XII, p. 273.

Ihre Nahrung besteht aus kleinen Krabben; ich habe 40 *F.l.* untersucht und bei 7 davon Reste von Krabben gefunden, deren Kephalothorax etwa 1—1½ cm^2 gross war. Dabei zeigte es sich, dass der Chitin- und Kalk-hältige Hautpanzer mit verdaut wird. Die Reste liessen sich noch determinieren; sie gehörten zu den Gattungen *Sesarma* und *Dotilla* (*brevitarsis* DE MAN?) *). Da die Scheren fehlten, liess sich die Art nicht mehr mit Sicherheit feststellen.

Einmal überraschte ich eine *F.l.* beim Verzehren einer grösseren Krabbe, deren Kopfbruststück 3 cm breit war. Sie verschwand aber mit ihrer Beute in einem Schlammloch und entzog sich der weiteren Beobachtung. Die Krabben, die hier ihre Höhlen in den Schlamm graben, erwiesen sich als *Sesarma taeniolata* WHITE. *).

Von den 40 im Februar 1930 untersuchten *F.l.* besassen 4 Embryonen und zwar 3, 4, 4, 5 Stück, welche alle bereits weit entwickelt waren. Im Mai fing ich einige 20 cm lange *F.l.*, deren offener Annulus umbilicalis davon zeugte, dass sie erst vor kurzem geboren wurden.

Um die Giftwirkung kennen zu lernen, verrieb ich die beiden Giftdrüsen einer 60 cm langen *F.l.* mit 1.5 cm^3 physiologischer Kochsalzlösung und spritzte von dieser Emulsion einer erwachsenen Hausratte [*Rattus rattus diardi*] 0.5 cm^3 an der Schwanzwurzel unter die Haut. Die Ratte zeigte nichts und lebte noch nach 48 Stunden.

Eine 3.5 cm lange Krabbe (*Sesarma taeniolata* WHITE) erhielt 0.6 cm^3 in die Leibeshöhle. Im ersten Augenblick lief sie flink weg; ihre Bewegungen wurden jedoch rasch langsamer. Nach 2 Minuten konnte sie nicht mehr laufen; nach 3 Min. bewegte sie kaum noch ihre Beine und starb 4 Min. nach der Injektion.

Eine kleinere Krabbe derselben Art, der 0.2 cm^3 der Emulsion in den Kephalothorax gespritzt wurde, begann zu schäumen. Auch sie lief im Beginn flott herum. Nach 8 Minuten aber wurden ihre Bewegungen langsamer; nach 12 Min. konnte sie sich, auf den Rücken gelegt, nicht mehr zurückdrehen. Nach 38 Min. war sie tot.

Ein 6 cm langer Frosch (*Rana* spec.), dem 0.4 cm^3 unter die Haut des Oberschenkels gespritzt wurde, zeigte keine Krankheitserscheinungen und lebte noch nach 48 Stunden.

Morphologisch ist an diesen *F.l.* von Cheribon nichts wesentliches zu bemerken. Die erwachsenen Schlangen sind alle oberseits einfärbig dunkel bleigrau; die seitlichen 4 Schuppenreihen, die Unterseite und die Supralabialia sind weisslich (*F. unicolor* GRAY). Junge *F.l.* sind heller grau und mit in mehreren Längsreihen angeordneten kleinen, schwarzen Flecken gezeichnet. Sq. 25—27;V.152—158 (die beiden letzten geteilt) A. 1/1; Sc. 31—40; Lo.0; Oc. 1—2; T.1+2,2+3; Lab.5.

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*) Die Bestimmung verdanke ich Fräulein VAN BENTHEM JUTTING vom Buitenzorger Museum und Herrn DR. VERWEY vom „Laboratorium voor het Onderzoek der Zee" in Batavia.

Cerberus rhynchops.

Auch *C.rh.* zeichnet sich in diesem Terrain durch geringe Scheu vor dem Menschen aus, wenn auch nicht in dem frappierendem Grade wie *Fordonia leucobalia*. Ich sah *C.rh.* niemals freiwillig das nasse Element verlassen; sie lässt sich auf dem Wasser treiben, liegt auf dem schlammigen Boden oder an den Rändern der Kanäle und kriecht langsam zwischen den Ufersteinen oder Pflanzen umher, auf der Suche nach Fischen. Wenn man sie erschreckt, taucht sie behende in dem schmutzigen Wasser unter. Jedoch gehört auch sie noch immer zu jenen Schlangen, die am leichtesten zu fangen und zu beobachten sind, da sie ruhig ihrer Fischjagd nachgeht, wenn man sich nur einigermassen still verhält.

15 *C.rh.*, deren Mageninhalt ich untersuchte, enthielten keine erkennbaren Reste. Einmal jedoch gelang es mir, eine 70 cm lange Schlange in einem niedrigen Tümpel auf der Jagd nach einem Siluriden [*Clarias batrachus*] zu beobachten. 10 Min. lang konnte ich Zeuge des fruchtlosen Kampfes sein; hierauf fing ich die Schlange, die erst auf dem Trockenen den 16 cm langen Fisch loslies. Er lebte noch nach 6 Stunden, schien also von dem Gift der *C.rh.* nicht tangiert zu sein. Diese Beobachtung interessierte mich besonders darum, weil mir Herr J. MENDEN, der in Cheribon eine Naturalienhandlung besitzt, einmal erzählte, er habe hier vor einiger Zeit eine halbtote Schlange gefunden, deren Körper beiderseits von den verknöcherten Strahlen der Flossen eines solchen Fisches durchbohrt war. Da *Clarias batrachus* (sowie noch andere Welse) ein Sperrgelenk besitzt, welches die gespreizten Stacheln fixiert, so kann diese gefährliche Waffe der Schlange (wenn es ihr überhaupt gelingt, den Fisch zu verschlingen) leicht verderblich werden. Tatsächlich standen auch bei jenem Wels, den die gefangene *C.rh.* festhielt, die Stacheln der Brustflossen maximal gespreizt und fixiert.

Dass der Fisch noch nach Stunden am Leben war, nachdem er lange von der opisthoglyphen *C.rh.* festgehalten wurde, veranlasste mich, einige Versuche zu unternehmen, um einen Eindruck von der Giftwirkung zu bekommen. Ich nahm 3 Cypriniden, Goldkarpfen von 10 cm Länge, drückte alle Zähne der lebenden Schlange fest durch die Schuppen hindurch und hielt sie so 20 Sekunden lang fest. Alle drei Fische blieben am Leben.

Hierauf verrieb ich die beiden Giftdrüsen einer erwachsenen, kräftigen *C. rh.* mit 1 cm^3 Kochsalzlösung und spritzte davon 2 zehn Zentimeter langen Cypriniden je 0.1 cm^3 in die Schwanzmuskulatur. Nach 2 Minuten legte sich der eine Fisch auf die Seite, versuchte sich mehrmals aufzurichten, was ihm aber nicht gelang. Nach 12 Minuten trieb er tot im Wasser. Der zweite jedoch war nach 24 Stunden noch am Leben!

Von 2 anderen Cypriniden, die von der gleichen Emulsion je 0.2 cm^3 intramuskulär erhielten, starb der eine nach 9 Minuten, während der andere nach 24 Stunden noch am Leben war.

Hierauf erhielt ein weiterer Fisch 0.4 cm^3 intramuskulär in die Schwanzwurzel und starb nach 10 Minuten.

Ein anderer Goldkarpfen, dem 0.4 cm^3 in die Leibeshöhle gespritzt wurde, starb nach 5 Stunden.

Krabben erwiessen sich gegenüber dem Gift von *C.rh.* einigermassen empfindlicher. Spritzte ich einer Krabbe mit einem Cephalothorax von 4 cm Breite eine ganze Giftdrüse (emulgiert in 0.2 cm^3 Kochsalzlösung) in die Leibeshöhle, so war sie in wenigen Sekunden tot. Bei ½ Giftdrüse in 0.1 cm^3 dauerte es bis zum Tode 13 Minuten.

Eine erwachsene Hausratte [*R.r. diardi*], die 2 ganze Giftdrüsen in 0.8 cm^3 Lösung unter die Haut der Schwanzwurzel gespritzt erhielt, starb nach 2 Stunden und 42 Minuten. Eine andere, der I Drüse in 0.5 cm^3 Lösung eingespritzt wurde, erlag der Vergiftung nach 12 Stunden.

Wenn derartige Versuche auch niemals eine naturgetreue Kopie der Bisswirkung im Freien reproduzieren, so lehren sie immerhin soviel, dass das Gift dieser Opisthoglyphen keine, oder eine nur sehr untergeordnete Rolle bei der Überwältigung der Beute spielt. Als ich im Juni 1930 Herrn MENDEN ersuchte, mir einige *C.rh.* fangen zu lassen, erhielt sein Sammler beim Fang einer starken Schlange dieser Art einen kräftigen Biss in den Finger. Als der Mann eine halbe Stunde später nach Hause kam, waren — wie Herr MENDEN mir berichtete — 6 Stichwunden auf dem Finger zu sehen. Sie wurden gut ausgedrückt und mit Jodtinktur behandelt. Schwellung war weder jetzt noch später zu bemerken; auch fehlten lokale Schmerzen. Wohl behauptete der Gebissene, dass er sich in der Nacht fieberhaft fühlte, was aber ebensogut psychisch bedingt sein kann, als die Folge einer Intoxikation.

Die Färbung und Zeichnung entspricht der Beschreibung in Boulengers Catalogue of Snakes. Ihre Pholidose weicht in keinem Punkte bemerkenswert ab: Sq.23; V.148—151; A.1/1; Sc.53—63; 4 Supralabialia in Berührung mit den vorderen Kinnschildern; Schuppen sehr stark gekielt; 10 Supralabialia.

NOTES ON FRESHWATER MOLLUSCA FROM THE MALAY ARCHIPELAGO

by

TERA VAN BENTHEM JUTTING

(Zoological Museum, Buitenzorg)

1. East Indian Planorbidae.

The family of Planorbidae with its numerous and various members in European waters is rather poorly represented in the Malay Archipelago. It is not the number of species which is so very small, there have been described 12 Planorbis and 2 Segmentina. But most of them seem to be very local and with the exception of *Planorbis exustus* they are of small size. Thus they never form such an important element in the freshwater fauna in this region as their congeners do in palaearctic and nearctic waters.

Most probably, however, continued investigation will throw more light on the specific position of different forms and on their distribution. A few collecting trips in Java have already shown me that the javanese species at least have a wider dispersal than hitherto has been supposed.

Paravicini and Van Heurn stated in 1922 (Natuurk. Tijdschr. Ned. Indië, Vol. 82, p. 31) that *Planorbis convexiusculus* in Java is one of the freshwater mollusks which are everywhere to be found.

Here follows a list of all the species described from the Dutch East Indies:

Planorbis	
badae Bollinger 1914	Celebes
convexiusculus Hutton 1850	Sumatra, Java, Lombok, Celebes, Soemba, Boeroe
elberti Haas 1912	Lombok
exustus Deshayes 1834	Sumatra
infralineatus Martens 1867	Java
montrouzieri Gassies 1857	North New Guinea
proclivis Martens 1897	Sumatra
sagoensis Bullen 1906	Sumatra
sarasinorum Bollinger 1914	Celebes
sumatranus Martens 1897	Sumatra
tondanensis Quoy & Gaim. 1833	Celebes
turbinellus Tapp. Can. 1883	Aroe Ids.
Segmentina	
calathus Benson 1850	Sumatra, Java, Aroe Ids.
congenera Böttger 1915	Aroe Ids.

In this summary only 3 species are mentioned from Java: *Planorbis convexiusculus* (= *compressus*) and *infralineatus* and *Segmentina calathus*. We will discuss the Planorbis first. (Fig. 1). For a better comparison their distinctive characters are placed here side by side (vide description VON MARTENS, Malak. Blätt. Vol. 14, 1867, p. 213).

	convexiusculus	*infralineatus*
1.	testa subdepressa	testa depressa
2.	supra leviter	supra leviter
3.	infra vix immersa	infra vix immersa
4.	striatula	striatula
5.	sculptura spirali nulla	infra lineis subtilibus spiralibus sculpta
6.	angulo peripherico plus minusve obsoleto	medio angulata
7.	pallide cornea	luteobrunnea
8.	nitidula	—
9.	anfractibus 4, depresso teretes	anfractibus 4½—5
10.	sutura sat profunda distincti	sutura sat profunda distincti
11.	modice involuti	modice involuti
12.	apertura obliqua	apertura obliqua
13.	ovata	ovata
14.	peristomate tenui	peristomate intus albolabiata
15.	diam. maj. 4½, min. 4, alt. 1½ mm	diam. maj. 6½, min. 5, alt. 2 mm
16.	apert. lat. 2, alt. 1 mm.	apert. lat. 2½, alt. 1½ mm

Apart from the dimensions, only the points 1, 5, 6, 7, 8 and 14 present differences between the two forms. To these BÖTTGER (Ber.Senck.Naturf.Ges. 1891, p. 245) in discussing *P. infralineatus* adds the very glossy shell (this in fact renders point 8 of no further distinctive importance), the light horny white colour and the more expanded aperture. At the same time however, this author doubts the value of such characteristics, as all of them (except the spiral striation) occured in indian and chinese shells of *P. convexiusculus* as well. In concluding he remarks: "I fear that closer observation would finally remove this hitherto undisputed species to the group of the very variable *compressus* forms".

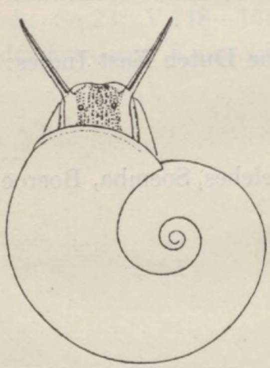


Fig. 1. *Planorbis convexiusculus* HUTTON Koeripan. (× 7)

As I happened to have for examination a fairly extensive series of javanese Planorbis from different localities I tried to find out whether *P. infralineatus* should be maintained as a separate species.

To begin with I give an enumeration of the collecting-places:

Lake on E. slope of Mount Patoeha, West Java, 1500 m alt. 20. IV. 1930.

Telaga Patengan on W. slope of Mount Patoeha, West Java, 1600 m alt. 9. VI. 1930.

Lake near Koeripan, vicinity of Buitenzorg, West Java, 200 m alt. 20. VII. 1930.

Lake at Tjibodas, West Java, 1400 m alt. 28. VII. 1930, coll. LIEFTINCK.

Telaga Sewiwi, Dieng plateau, Central Java, 2000 m alt. 11. VIII. 1930.

Lake of Tjigombong, vicinity of Buitenzorg, West Java, 500 m alt. 1. IX. 1930.

There is a great deal of variation among them. Typical *convexiusculus* and typical *infralineatus* are present, but between these lies an almost continuous series of transitional forms of which the accompanying figures may give an idea. From shells of *convexiusculus* with rounded periphery and without any trace of spiral striation (Fig. 2) we pass to forms with an obsolete peripheral angle (Fig. 3) then to such with a noticeable carina which are

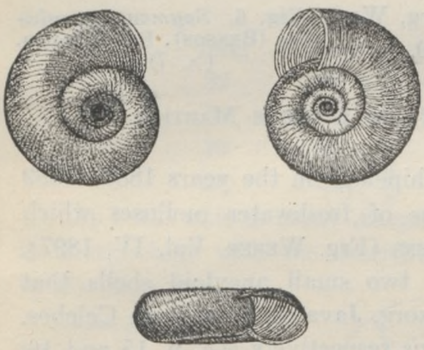


Fig. 2. *Planorbis convexiusculus* HUTTON. Lake on Mt. Patoeha. (× 5)

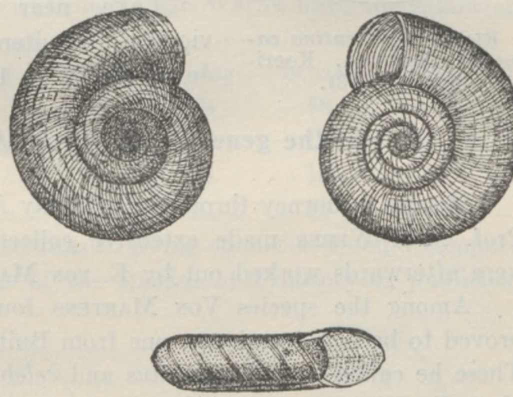


Fig. 3. *Planorbis convexiusculus* HUTTON. Telaga Patengan. (× 5).

immediately connected with keeled forms having a more or less conspicuous spiral structure besides (Fig. 4). Finally this is linked to shells agreeing perfectly with the original diagnosis of *infralineatus* the only difference I could observe being the occurrence of spiral lines on either top or basal side or on both.

Shells of *convexiusculus* possessing a peripheral angle as represented in Fig. 3 belong to the var. *siamensis* MARTENS. Those with a distinct carina may be termed var. *japonica* MARTENS. The stages 3 and 4 are two phases of *infralineatus* not sufficiently separated. The presence of a peripheral angle is a characteristic which seems to become more pronounced with advanced age, hence the smaller individuals as a rule are more like *convexiusculus,* the larger ones like *infralineatus.*

Fig. 4. *Planorbis convexiusculus* HUTTON. Koeripan. (× 5)

In concluding I give it as my opinion that among the javanese Planorbis two distinct species can no longer be maintained but that we ought better to

regard *convexiusculus* and *infralineatus* as the extremes of a variation range with every possible transitional form between them.

In dealing with *Segmentina calathus* (BENSON) (Figs. 5 and 6) I have only to add a few more localities to the distribution of this species which as far as it concerns Java was only known from Buitenzorg (MARTENS, Erg. WEBER, 1897, p. 15).

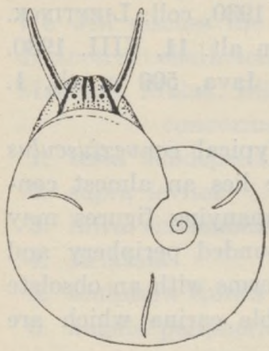


Fig. 5 *Segmentina calathus* (BENSON). Koeripan. (× 13).

Drains on cocoa-nut estate Pagandaran, near Dirk de Vriesbay, S. coast of West Java, 3. IV. 1930, coll. B. POLAK.

Lake near Koeripan, vicinity of Buitenzorg, West Java, 20. VII. 1930.

Fig. 6. *Segmentina calathus* (BENSON). Pagandaran. (× 7).

2. On the generic position of Ancylus javanus MARTENS.

During a journey through the Malay Archipelago in the years 1888—1889 Prof. MAX WEBER made extensive collections of freshwater molluscs which were afterwards worked out by E. VON MARTENS (Erg. WEBER, Vol. IV, 1897).

Among the species VON MARTENS found two small ancyloid shells that proved to be new to science, one from Buitenzorg, Java and one from Celebes. These he called *Ancylus javanus* and *celebensis* respectively (l.c. p. 15 and 16, pl. 1, fig. 35—37 and 38—39, pl. 12, fig. 8). He points out further how these records form a most welcome addition to our knowledge of the distribution of the genus as until that time *Ancylus* was known from India and Ceylon, the Philippines and North Australia, but not from the Malay Archipelago.

Two other ancyloid mollusks (*adhaerens* and *pileolus*) have since been found in Celebes by Messrs. P. and F. SARASIN and described in Die Süsswasser-mollusken von Celebes 1898, p. 84—88. The authors created a new genus for them: *Protancylus,* on account of anatomical details and they add: had we possessed shells only we would certainly have united the two present species with *Ancylus*.

Now it remained uncertain whether *Ancylus javanus* and *celebensis* might not possibly also be included in this new genus. No details of structure however were known to provide the necessary information, except a description and a figure of the radula of *celebensis* which was said by VON MARTENS to show some resemblance to that of *Velletia lacustris*.

Fig. 7. Shell of *Protancylus javanus* (MARTS). Telaga Warna (× 7).

In the beginning of May 1930 when visiting the little freshwater lake Telaga Warna near Buitenzorg, Java, situated at about 1400 m alt. I collected several specimens of *Ancylus javanus* (Fig. 7) which were rather common at moderate depth

on leaves which had fallen into the pond. Afterwards I found the same species under similar conditions in a little stream in the Botanical Gardens at Buitenzorg (alt. 270 m) and in Lake Tjigombong, some miles off Buitenzorg (alt. 500 m).

On comparing my shells with VON MARTENS' description it struck me at once that he mentions the apex being curved to the left, but in his figure it is drawn with the top inclined to the right, as is also the case in all my specimens. We may safely assume that VON MARTENS obviously confounded front and rear end of the shell. Also in his measures of the dimensions of the shell a mistake must have crept in. For if the shell length is 2.5 mm, the corresponding breadth cannot be ⅓ mm. A reduction from the figures 35 and 36 on pl. 1 leads to the conclusion that probably 1.3 mm is meant.

A number of 12 of the larger shells from Telaga Warna have the following dimensions (in $^1/_{10}$ mm):

long	broad	long	broad	long	broad
32	24	27	19	24	18
30	20	26	20	23	17
29	21	26	19	21	16
28	21	25	19	21	15

As I was able to study *Ancylus javanus* in living condition I could compare its morphology with the descriptions of the species of Protancylus published by the SARASINS.

The presence of long and slender tentacles, of a respiratory sac with gill, of a muscular stomach and especially the structure of the radula serve to remove our javanese Ancylus to the genus *Protancylus*.

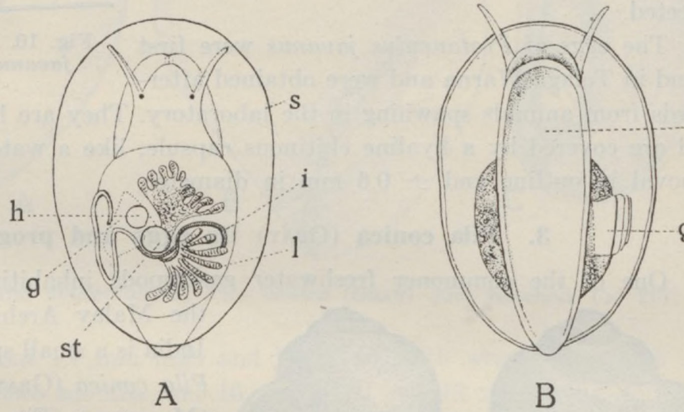


Fig. 8. *Protancylus javanus* (MRTS.). Telaga Warna. (× 14). *f.* foot, *g.* gill, *h.* heart, *i.* intestine, *l.* digestive gland, *s.* shell, *st.* stomach.

A sketch of the animal from above and below (Fig. 8) together with a figure of the shell (Fig. 7), radula (Fig. 9) and egg (Fig. 10) illustrate these few notes.

The radula is 0.6 mm long and consists of 120 transverse rows, each containing 35 or 37 teeth. The rhachis is provided with 2 cusps, two or three neighbouring laterals bear 4, those following outward 5—7 cusps or more, but because of their minute size the exact number is often difficult to count. In the last four of five teeth of each row the number of cusps diminishes, every tooth becoming also smaller.

On comparing this analysis with SARASIN's description of the radula of *Protancylus adhaerens* we find some differences. In the first place the number of teeth in every transverse row of *adhaerens* is 61. SARASIN observed only 3 cusps at each of the four innermost laterals next to the rhachis. Moreover in his figure of the marginal teeth the cusps are relatively smaller and a little more numerous than in the case of *javanus*.

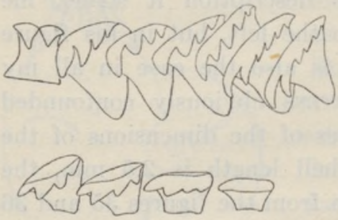


Fig. 9. Elements from radula of *Protancylus javanus* (MRTS) (× 600).

Finally if we remember VON MARTENS' words alluding to the resemblance of the radula in *Velletia lacustris* and *Ancylus celebensis* we may almost feel sure that we have to do with a *Protancylus* in the last named species also. Probably the SARASINS supposed this, but they did not precisely state it as their opinion.

This likeness of the radula in *celebensis* and *lacustris* however, is a very superficial one. Not only are the transverse rows of *celebensis* straight or nearly so, in contradistinction to the condition in *lacustris* where they are distinctly flexed, but also the shape of every single tooth is so decidedly different, that any trace of a closer relation between these two mollusks must positively be rejected.

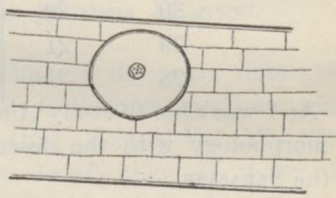


Fig. 10. Egg of *Protancylus javanus* (MRTS) (× 16).

The eggs of *Protancylus javanus* were first found in Telaga Warna and were obtained afterwards from animals spawning in the laboratory. They are laid singly on leaves and are covered by a hyaline chitinous capsule, like a watch glass, circular or suboval in outline and ± 0.6 mm in diameter.

3. Pila conica (GRAY) its eggs and progeny.

One of the commoner freshwater gastropods inhabiting a great part of the Malay Archipelago and British India is a small species of apple snail, *Pila conica* (GRAY) syn. *Pila scutata* (MOUSSON). (Fig. 11).

Fig. 11. *Pila conica* (GRAY), Lake Tjigombong. (nat. size).

It lives at small depths among the waterplants upon which it feeds. In March 1930 I observed a female spawning in Lake Tjigombong, West-Java. In order to deposit her eggs she had climbed against an old tree trunk which floated on the water. And there with the front part of her body and shell emerged, the eggs were laid just above the waterline in a cluster of

about a hundred. (Fig. 12). They are round, each being circa 3 mm diameter.

At the moment of production the eggshells are gelatinous and sticky but soon afterwards they become hard and calcareous. The whole eggmass of this species is not enveloped by a common calcareous layer as is the case with the spawn of its congener, the large *Pila ampullacea,* also an inhabitant of the East Indian Archipelago. *Pila conica* resembles in this respect more the British Indian *Pila globosa* (SWAINSON) (PRASHAD, Mem.Ind.Mus. Vol. 8, 1925, p. 69 and p. 91; BAHL, Ibid. Vol. 9, 1928, p. 1).

Fig. 12. Eggs of *Pila conica* (GRAY). Lake Tjigombong. (nat. size).

The egg mass was removed from Lake Tjigombong to the laboratory at Buitenzorg and here after a week the first young snail hatched (Fig 13). During the following days others appeared and in about ten days all had come out. They could be kept and brought up very well in small glass vessels and were fed on Elodea and minute waterweeds from stones. In this way the animals

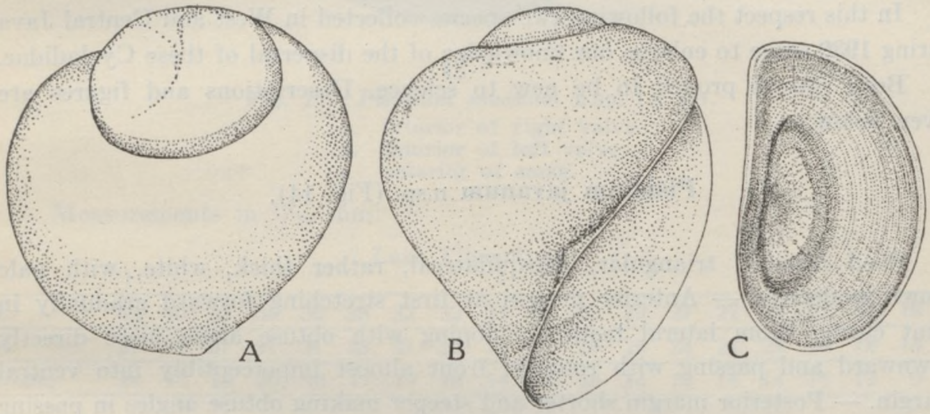


Fig. 13. Shell and operculum of *Pila conica* (GRAY) just hatched. (× 20).

which measured about 1.7 mm high and broad at birth were 9 mm high and 7 mm broad after two months and 16 mm high and 13 mm broad after six months.

4. East Indian species of Pisidium and Sphaerium.

Our knowledge of the small East Indian freshwater mussels belonging to the genera Pisidium and Sphaerium is rather scanty. It is true that on the whole these bivalves are far less numerous in the Malay Archipelago than in European waters, but still a few species have been recorded. Perhaps their small size may explain why they have often been overlooked and moreover they seem to be very locally distributed, although the archipelago with its various freshwater situations, lakes, ponds and rivers is rich in apparently

appropriate habitats. Yet I am sure that further research will bring to light several other forms in different localities.

Previously 3 species of Pisidium and 5 species of Sphaerium were known viz.:

Pisidium australe	LAMARCK 1818	Timor	alt. ?
„ *sumatranum*	MARTENS 1897	Sumatra	„ 1150 m
„ spec.	v. B. JUTTING 1928	Soemba	„ 100 m
Sphaerium alticola	KOBELT 1913	New Guinea	„ 3800 m
„ *haasi*	BÖTTGER 1915	Aroe Ids.	„ ?
„ *cecilae*	PRASHAD 1921	Sumatra	„<2400 m
„ *buruense*	v. B. JUTTING 1927	Boeroe	„ 850 m
„ *ranae*	„ „ „ 1927	„	„ 750 m

Most of the species seems to live by preference at considerable elevation above the sea, only the Soemba and the Aroe shell being collected in the low lands whereas of *Pisidium australe* no altitude is recorded. On the isle of Java however no representatives of either genus had so far been found.

In this respect the following two species collected in West and Central Java during 1930 serve to enlarge our knowledge of the dispersal of these Cycladidae.

Both species proved to be new to science. Descriptions and figures are given below.

Pisidium javanum n.sp. (Fig. 14).

Shell rounded triangular, inaequilateral, rather thick, white, with pale brown epidermis. — Anterior margin at first stretching forward gradually in faint curve. From lateral teeth on sloping with obtuse angle more directly downward and passing with rounded front almost imperceptibly into ventral margin. — Posterior margin shorter and steeper making obtuse angles in passing to dorsal and ventral margins. — Ventral margin rounded. — Umbones moderately prominent, more so in older than in young specimens and in the former recurved sligthly inward. — Close concentrical striation like flat ribs on the whole exterior of the shell except on the nepionic part which is smooth. — Right valve bears two laterals on each side, the dorsal ones being smallest, the anterior ventral ones powerful and causing a tooth-like protuberance in this part of the hinge. There is one curved cardinal, rather low in front, becoming better developed and more prominent towards the rear. — Left valve has one lateral on each side and two cardinals of which the posterior-dorsal one is a long, low ridge, the antero-ventral one a short, high plica. — Ligament short, hardly visible exteriorly.

18 Specimens have been collected at Lake Tjigombong, West Java, 500 m alt. and 18 specimens in a little mere near Dolog river, Dieng Plateau, Central Java, alt. 2000 m.

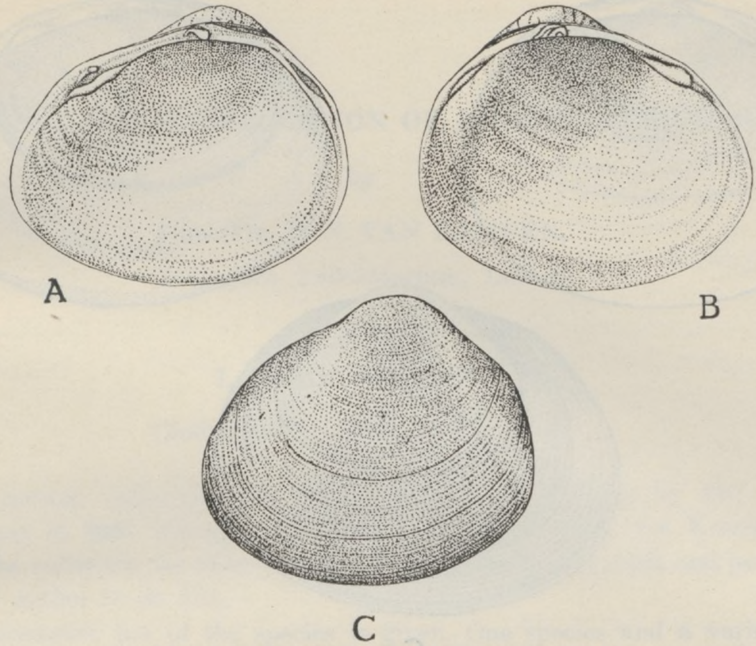


Fig. 14. *Pisidium javanum* n.sp. (× 10).
a. interior of right valve
b. interior of left valve
c. exterior of same.

Measurements in $^1/_{10}$ mm:

Lake Tjigombong.

	[1]																	
L.	43	40	37	36	36	35	32	32	31	30	30	29	27	27	27	27	22	18
H.	37	35	31	31	31	28	27	27	26	25	25	25	24	24	24	23	18	14
Diam.	24	22	19	20	20	17	17	16	14	16	16	14	14	14	14	15	12	9

River Dolog.

	[1]																	
L.	36	36	35	34	32	31	30	30	29	27	27	25	24	24	22	21	20	19
H.	31	31	31	30	28	27	27	25	25	24	23	22	21	20	18	16	17	17
Diam.	22	20	22	20	20	18	16	15	18	13	14	12	12	12	11	10	9	8

[1]) Type specimen

The type specimen is preserved in the Zoological Museum at Buitenzorg, the paratypes partly in this same Museum and partly in the Zoological Museum at Amsterdam.

Sphaerium javanum n.sp. (Fig. 15).

Shell rounded oviform, subaequilateral, not very thick, white, with pale brown epidermis. — Anterior margin sloping gradually obliquely downward without notable angle off the lateral teeth and passing with rounded front almost imperceptibly into ventral margin. — Posterior margin a little shorter

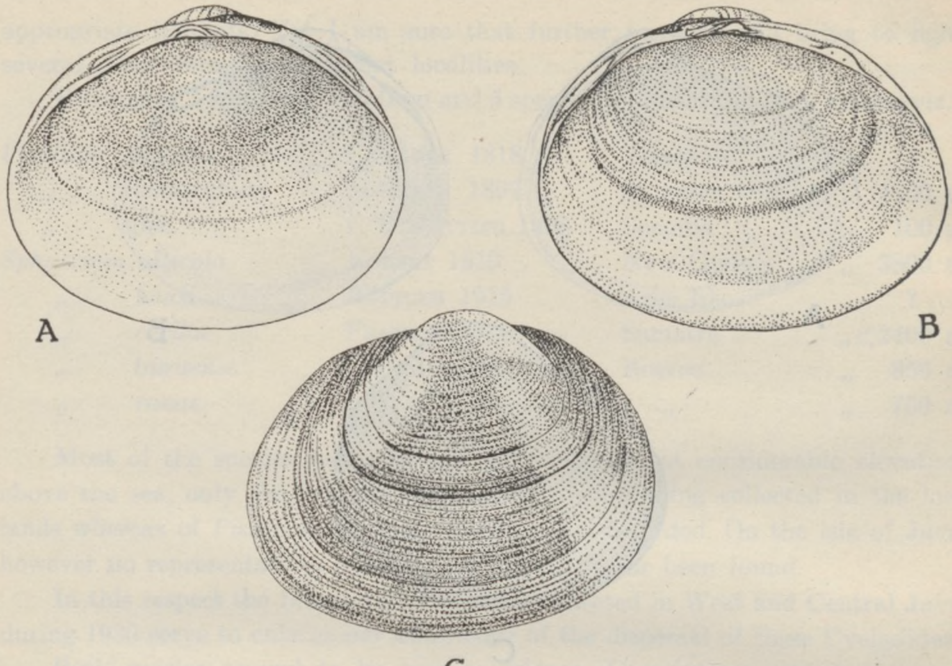


Fig. 15. *Sphaerium javanum* n.sp. (× 10).
a. interior of right valve,
b. interior of left valve,
c. exterior of same.

and steeper making a very faint angle near the lateral teeth and thence passing without clear markation into ventral margin. — Ventral margin rounded. — Umbones hardly prominent, not recurved inward. — Exterior of shell very closely concentrically striated, except on the nepionic part which is smooth. — Right valve bears two laterals on each side, the dorsal ones being smallest, the antero-ventral ones thickest. There is one cardinal tooth curved to a nearly right angle, the posterior side giving off a dorsal branch on its way.— Left valve has one lateral on each side and two cardinals. Of these the postero-dorsal one is a nearly straight ridge, the antero-ventral one a short but high plica. — Ligament short, hardly visible exteriorly.

27 Specimens have been collected in a little mere near Dolog river, Dieng plateau, Central Java, alt. 2000 m.

Measurements in $^1/_{10}$ mm:

	1)																										
L.	51	50	49	48	46	45	43	43	43	42	41	39	37	35	35	35	33	30	29	29	27	26	26	25	25	21	19
H.	42	42	40	39	38	37	36	36	35	34	34	32	32	30	29	29	25	24	24	24	23	21	21	20	19	17	16
Diam.	26	26	25	25	25	23	24	23	21	21	21	20	20	18	18	18	17	14	14	14	13	12	11	11	11	10	9

1) Type specimen

The type specimen is preserved in the Zoological Museum at Buitenzorg, paratypes partly in this same Museum and partly in the Zoological Museum at Amsterdam.

NOTES ON A SMALL COLLECTION OF AMPHIBIA FROM SUMBA.

by

PROF. DR. P. N. VAN KAMPEN,

(Zoölogisch Laboratorium, Leiden)

and

L. D. BRONGERSMA,

(Zoölogisch Museum, Amsterdam).

The present collection was brought back from Sumba by Dr. K. W. DAMMERMAN in 1925. Through different circumstances Prof. VAN KAMPEN who received the collection for identification could not finish this work and permitted the junior author to do this.—

An annotated list of the species is given. One species and a variety are recorded for the first time from this island.

HYLIDAE.

Hyla everetti BLGR.

BOULENGER, Ann. Mag. Nat. Hist. (6), 19, 1897, p. 509; VAN KAMPEN, Amph. Indo-Austr. Arch., 1923, p. 51.

Three specimens were collected at Laora, 100 meters above sea-level, April 1925.

BREVICIPITIDAE, Brevicipitinae.

Kaloula baleata (S. MÜLL.)

Bombinator baleatus, S. MÜLLER, Verh. Bat. Gen. 16, 1836, p. 96.

Callula baleata, BOULENGER, Cat. Batr. Sal. Brit. Mus. 1882, p. 169, figs of hand and foot.

Kaloula baleata, VAN KAMPEN, Amph. Indo-Austr. Arch., 1923, p. 148, fig. 21.

One specimen from Laora, April 1925.

RANIDAE.

Rana cancrivora verruculosa ROUX.

Rana tigrina var. *verruculosa*, J. ROUX, Zool. Jahrb. Syst. 30, 1911, p. 504.

Rana verruculosa, BOULENGER, Rec. Ind. Mus. 20, 1920, p. 16; VAN KAMPEN, Amph. Indo-Austr. Arch. 1923, p. 172; M. A. SMITH, Proc. Zool. Soc. London, 1927, p. 207.

Rana cancrivora verruculosa, DUNN, Amer. Mus. Nov. 315, 1928, p. 5.

Rana verruculosa, MERTENS, Senckenbergiana 10, 1928, p. 230.

Rana cancrivora verruculosa, MERTENS, Abh. Senckenb. natf. Ges. 42, 1930, p. 213-214.

During the last years this frog has been the subject of much discussion. The different characters on which *R. verruculosa* was separated from *R. cancrivora* seem to be only of subspecific value. At the moment it is best to follow DUNN (l.c.) and take *verruculosa* as a variety of *Rana cancrivora.*

Seven specimens from Laora, April 1925.

In one specimen a vertebral band of the skin is bordered by broken-up ridges which are darkly coloured. This gives the impression of a light vertebral band. It is not white, however, as in specimens of *cancrivora* s. str. (in alcohol).

One specimen and seven juv. from Kambera, March 1925.

Two larvae from Kambera were referred to *Rana verruculosa* by the senior author. They agree very well with the description of larvae of *Rana c. cancrivora* (VAN KAMPEN l.c. p. 171).

Rana papua LESS.

Rana papua, LESSON, Voyage Coquille, Zool. II, 1, 1830, p. 59, pl. 7, fig. 1.

Rana papua, BOULENGER (part.), Cat. Batr. Sal. Brit. Mus. 1882, p. 64.

Rana florensis, BOULENGER, Ann. Mag. Nat. Hist. (6), 19, 1897, p. 508.

Rana florensis, varians and *papua*, BOULENGER, Rec. Ind. Mus. 20, 1920, p. 160, 165, 188.

Rana papua, VAN KAMPEN, Amph. Indo-Austr. Arch. 1923, p. 201.

Rana papua florensis, MERTENS, Senckenbergiana 9, p. 242.

Rana florensis, DUNN, Amer. Mus. Nov. 315, 1928, p. 6.

Rana papua florensis, MERTENS, Abh. Senckenb. natf. Ges. 42, 1930, p. 225, pl. 5, fig. 5.

Ten specimens from Kananggar, 700 meters above sea-level, May 1925.

Eight specimens from Mao Marroe, 450 meters above sea-level, May 1925.

This species was not yet recorded from the island. We can not follow MERTENS who describes specimens from the Lesser Sunda-isles as *R. papua florensis*. The difference between specimens from these islands and from New Guinea and Moluccas is only very slight. The tibiotarsal articulation reaches the nostril or beyond the tip of the snout. The characters given by MERTENS (1930) to distinguish the sexes, proved to be quite sufficient. Two specimens were found to be females (eggs) the others were male. All the males had the flat humeral gland and the tubercles on the back. As follows from the table with the measurement the length of the fore-limb is contained 1.6—1.5 $\times$ in the length of head and body in the two females. In the males the total length is 1.6—1.3 $\times$ the arm-length.

Of the two females one is darkly coloured, the other one light grey above. Two males are also darkly coloured above.

Two larvae were captured at Mao-Marroe. The largest measuring 56 millim. the second one 38 millim. total length. The distance between the eyes is equal to that between the nostrils and to the width of the mouth. In the first specimen the body is one time and a half as long as broad; the tail is four and half times as long as high and twice the body length.

The series of labial teeth are $\frac{\overset{1}{2\;\;2}}{\underset{2}{1\;\;1}}$.

MEASUREMENTS OF *RANA PAPUA* LESS.

Locality	Kananggar, 700 m above sea-level, V - 1925.										Mao Marroe, 450 m above sea-level, V - 1925.							
Sex	♀	♀	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂	♂
Snout to vent	70.-	66.-	51.5	44.-	43.-	42.5	42.-	42.-	41.5	39.-	41.5	41.5	41.5	41.-	40.-	39.-	39.-	38.-
Length of head	24.-	23.5	18.-	16.-	16.5	16.-	16.-	15.5	16.-	14.5	16.-	16.-	15.5	15.-	15.-	16.-	14.5	15.-
Width of head	24.-	24.-	17.5	14.5	15.-	15.5	15.5	13.-	14.5	13.5	15.-	15.-	15.5	15.-	14.5	15.-	13.5	15.-
Snout	9.5	9.5	7.5	6.5	6.-	6.-	6.5	6.-	6.5	5.-	6.5	6 5	7.-	6.-	6.-	6.-	6.-	6.-
Eye	9.5	9.-	7.-	6.5	6.-	6.-	6.5	7.-	6.5	5.5	6.-	6 5	6.-	6.-	6.-	6.-	6.-	6.-
Interorb. width	6.-	6.-	5.-	5.-	4.5	5.-	4.5	5.-	4.5	4.-	4.5	5.-	4.5	5.-	4.-	4.5	5.-	5.-
Tympanum	6.-	6.-	5.-	5.-	4 5	5.-	4.5	5.-	4.5	4.-	4.5	5.-	5.-	5.-	4.-	4.5	5.-	5.-
Fore limb	45.-	43.-	32.5	29.-	30.-	31 5	30.-	31.-	29.5	25.-	30.-	29.5	32.-	29.-	30.-	29.-	30.-	29.-
First finger	10.5	11.5	8.-	7.-	6 5	7.-	6.5	7.-	7.-	7.-	6.5	6.5	6.5	6.5	6.5	6.5	7.-	7.-
Second finger	8.5	9 5	7.-	5.5	5.-	6.-	5.5	5.5	6.-	6.-	5.5	5.-	5.-	5.-	5.-	5.-	5.5	6.-
Third finger	14.-	14.-	10.5	9.-	7.-	8.-	8.-	9.-	8.-	8.-	8.5	8.-	8.5	8.-	8.-	7.-	7.-	8.5
Fourth finger	10.-	9.-	6.5	5.5	5.5	6.-	6.-	5.5	6.5	6.-	5.5	5.5	6.5	5.-	5.-	5.5	5.5	6.5
Hind limb	121.5	118.-	91.-	76.-	77.5	78.5	76.5	71.-	77.5	70.5	71.-	74.-	75.5	68.-	68.-	71.5	69.-	68.-
Tibia	41.-	39.-	29.5	25.-	25.-	25.5	25.-	25.-	24.-	22.-	24.-	23.5	25.-	22.-	21.5	23.-	22.5	24.5
Foot	35.-	33.-	26 -	21.-	22.-	21.5	23.-	23.-	20.-	20.5	20.-	20.-	22.-	18.-	18.-	21.5	19.-	19.-
Third toe	16.-	18.-	16.-	12.-	12.-	12.-	11.5	13.-	12.-	11.5	12.5	12.-	12.-	10.-	10.5	11.-	11.5	10.5
Fourth toe	28.-	26 -	22.5	16.5	18.-	18.5	18.-	20.-	17.5	17.-	16.5	18.-	18.-	15.-	16.-	17.-	18.-	15.-
Fifth toe	20.-	19.5	18.-	12.-	12.5	14.-	13.5	15.-	13.-	13.-	12.-	12.-	12.-	11.-	11.-	12.5	12.-	11.5

In the second specimen the body is nearly twice as long as broad; the tail is one time and a half the body length and four times as long as high. The series of labial teeth are as in the first specimen, the inner series of the lower lip is hardly interrupted.

These larvae agree very well with the description given by VAN KAMPEN (l.c. p. 202). According to MERTENS (1930) the series of labial teeth seem to vary in number to a great extent so that the difference of the larvae as described by DUNN and himself cannot be of specific value.

Rhacophorus leucomystax (KUHL).

Hyla leucomystax (KUHL) GRAVENHORST, Deliciae Mus. Zool. Vratislav, Fasc. 1, Lipsiae, 1829. p. 26.

Rhacophorus maculatus, BOULENGER (part.), Cat. Batr. Sal. Brit. Mus. 1882, p. 83.

Rhacophorus leucomystax, VAN KAMPEN, Amph. Indo-Austr. Arch. 1923, p. 246.

Two specimens from Kananggar, May 1925.

Five specimens from Laora, April 1925.

Rhacophorus leucomystax var. sexvirgata (REINW).

Hyla sexvirgata (REINW.) GRAVENHORST, Deliciae Mus. Zool. Vratislav, Fasc. 1, Lipsiae 1829, p. 28.

Rhacophorus maculatus var. *quadrilineatus*, BOULENGER, Cat. Batr. Sal. Brit. Mus. 1882, p. 84.

Rhacophorus leucomystax var. *sexvirgata*, VAN KAMPEN, Amph. Indo-Austr. Arch. 1923, p. 249, fig. 27.

Three specimens from Laora, April 1925.

This colour variation was not yet recorded from the island.

Leiden and Amsterdam, November 1930.

UEBER DIE VARIATION VON *LEPTOTRICHALUS PULLUS* KLN.

Von

R. KLEINE,

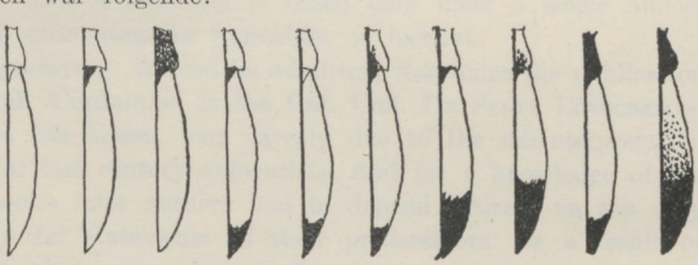
(Stettin).

Die habituellen Unterschiede sind bei den Lyciden durchgängig recht gering. Stösst schon die Trennung der Gattungen zuweilen auf Schwierigkeiten, so ist die Auseinanderhaltung der Arten noch schwieriger. Bei manchen Gattungen, so z. B. *Plateros, Ditoneces* und anderen wird die Festlegung der Art durch den äusserst vielgestaltigen Penis ermöglicht, bei anderen fällt leider auch dies Hilfsmittel fort, da die Penisformen sehr einheitlich sind. So muss denn, so unangenehm es auch ist, die Ausfärbung in grossem Ausmass zur Trennung der Arten herangezogen werden. Ohne Frage hat die Farbe nur untergeordneten systematischen Wert. Wenn durch Vergleich an genügend grossem Material die Konstanz der Farben sichergestellt ist, d.h. wenn man die Grenzen der Variationen kennt, ist der systematische Wert der Ausfärbung unbestritten. Das ist bei vielen Lyciden sicher der Fall und der Systematiker, der die Familie kennt, darf unbesorgt mit den Farben arbeiten. Leider kommen aber Arten vor, die jede Konstanz der Farben vermissen lassen und wo es nur möglich ist, an der Hand grösseren Materials vom gleichen Fundort und Tag sich ein Bild von der Variationsbreite zu machen. Eine solche Art ist *Leptotrichalus pullus* Kln.

In der Originalbeschreibung (Treubia IX, Livr. 4 p. 303) heisst es: „Schwarz, nur die Elytren mit Ausnahme des schmalen, schwarzen Hinterrandes lehmgelb.........” Der Typus entspricht demnach der Abb. 9. Die beigegebenen 10 Färbungsbilder geben einen Ueberblick, wie gross die Variationsbreite ist.

Mir stand ein grösseres Material zur Verfügung. Namentlich hatte Herr Drescher — Bandoeng recht schöne Tiere gesandt. Die Verteilung der einzelnen Variationstypen war folgende:

1	3 %
2	18 „
3	12 „
4	9 „
5	3 „
6	3 „
7	9 „
8	9 „
9	30 „
10	3 „



1 2 3 4 5 6 7 8 9 10

Leptotrichalus pullus Kleine.
Ueberblick über die Variationsbreite.

Die Typen 2 und 9 waren die häufigsten, von ihnen besitze ich ein copulierendes Pärchen. Die Zugehörigkeit der Männer ist durch Penisautopsie sichergestellt.

Die Ausbreitung der dunklen Elytrenzeichnung ist sehr wechselnd. Es kommen Stücke mit ganz hellbraunem schmalen Rand und solche mit dunklerem Rand vor. Die Ausdehnung und Vertiefung des dunklen Elytrenteiles geht soweit, dass, wie Abb. 10 nur noch eine undeutliche Gelbfärbung übrig bleibt. Die Ausfärbung des Schildchens ist sehr wechselnd. Der Prothorax kann ganz einfarbig hell, fleckig, hellbraun bis völlig tiefschwarz sein, alle Uebergänge kommen vor. Bei sehr differenten Stücken könnte man annehmen, es handle sich um verschiedene Arten. Penisautopsie muss dann den Ausschlag geben. Ein Vergleich ist nur mit *javanus* KLN. möglich. Es ist da zu beachten, dass die hellen Farbtöne bei *javanus* niemals lehmgelb, sondern dunkelorange sind. Die dunklen Farbentöne sind bei jener Art übrigens immer tiefschwarz. Neigung zur Variation war nicht vorhanden.

A REVISION OF THE GENUS *EPOPHTHALMIA* BURM. (ODON., CORDULIINAE),

with notes on habits and larvae.

By

M. A. LIEFTINCK,

(Zoölogisch Museum, Buitenzorg).

With 29 text-figures and one coloured plate.

INTRODUCTION.

Some time ago whilst occupied with a revision of the Indo-Australian members of the genus *Macromia* I had occasion to consult publications dealing with the closely allied genus *Epophthalmia.* At that time the material available to me for study was very poor; and discrepancies in literature as well as early difficulties over the determination of specimens I was obliged to borrow material from other collections, and make a careful study of all the already known species.

Thanks to the generosity of Odonatists, who had already become aware of the many problems in connection with defining the species of this most striking genus, important material gradually came under my notice: as a result of which I now contemplate making a revision of this genus.

Although I now have before me a comparatively large number of specimens, yet some of the known species of *Epophthalmia* are very poorly represented. This can be attributed partly to the very restricted occurrence of such species even in countries where the genus is well represented, and partly to the difficulty in capturing them owing to their swift flight. At the same time the number of species at present known to us is very small, and in more than one case our knowledge about their distribution is based only upon a single almost valueless label-record with inconcise indication of habitat.

With regard to synonymy; it must be admitted, that since the publication of MARTIN's monograph 'Cordulines' in the Cat. Coll. DE SELYS LONGCHAMPS, considerable confusion has arisen, very largely due to the misinterpretation of the correct views of last century Odonatists. And for a knowledge of the habitat of certain species later authors had to depend entirely on the very fragmentary and doubtful statements of their predecessors: as a result of which unreliable views when once accepted often become accepted.

In the following descriptions I have sometimes had to rely on the characters used by several authors many of which are ordinarily considered to be of

problematical value, as for example the colour pattern of the head and abdomen, and more especially the shape of the male anal appendages. But I have found that these features are sufficiently constant; and after taking into account other factors, it has been found possible to apply them with satisfactory results. They will perhaps aid in the recognition of at least most of the males, as far as available material allows.

To facilitate the recognition of the several species a comparative study of the neuration has been made: but, in contrast with so many other genera, including certain "groups" of the closely related genus *Macromia*, this study has led to disappointment, as no valuable neural characters could be found.

It is especially to be regretted that no more females could be obtained, this fact contributing in no small measure to the incompleteness of the present paper. For this reason I have refrained from making any generalizations regarding geographical influence; although in one widely distributed species, *E. vittata*, the tendency to develop well marked geographical subspecies seems to have reached an advanced phase — so much so in fact that I do not hesitate to regard this phenomenon as significant and possibly to be regarded as a natural result of prolonged isolation. In other cases of perhaps more slowly migrating species, e.g. *E. vittigera*, the development of subspecies within the eastern limit of its range is less striking and perhaps still in an initial stage; although the tendency to differ from the typical form in certain characters of minor importance can already be seen — these characters sometimes paralleling others of similar value in a very striking manner.

In the following historical review I have tried to fix the position of the genus in the subfam. Corduliinae. A brief key to the species is given, followed by a more amplified one: and finally each of the species is discussed separately. Contrary to my original plan, namely to give a very detailed description for each species, it has been found advisable to adopt the method of treatment just described. Firstly, because excellent descriptions already exist for at least three species; secondly, because it is my opinion that such detailed descriptions are liable to lead to confusion rather than to the ready identification of species; and thirdly, because many of the species have so much in common that undesirable repetition would be necessary.

In order to facilitate consultation of the best of existing descriptions references are given in heavy print under the heading of each species — including cases where the original description was copied or extracted.

At the end of this paper descriptions and figures of the full grown and young larvae of three species are given. Much attention was devoted to these larvae, although a full account of that of one of them has already been published by CABOT in his well known paper.

The figures appended are original camera lucida drawings; except for figures 20, and 28 which have been worked up by a native artist.

My thanks are due to Col. F. C. FRASER (Coimbatore), Dr. F. F. LAIDLAW (Uffculme), Mr. K. J. MORTON (Edinburgh), Dr. F. RIS (Rheinau) for their

generosity in loaning me all the specimens in their collections. Through the kindness of M. A. BALL I have been able to study all the *Epophthalmia* specimens in the Brussels Museum, formerly DE SELYS' collection. Mr. R. VAN EECKE has lent me the type of *E. australis* HAGEN from the Leiden Museum, and Dr. E. TITSCHACK (Museum Hamburg) has done me similar service as regards a lot of unidentified larvae and imagoes which proved to be of great interest.

It is my hope that the arrangement adopted, though it may hereafter be subject to revision, will fulfill the primary object to which this paper is directed, namely that of overcoming hesitation about devoting study to these beautiful Dragonflies.

November, 1930.

HISTORICAL.

The name *Epophthalmia* [1]) was first proposed by BURMEISTER in the second volume of his well known "Handbuch der Entomologie", 1839, p. 844 for a rather large number of Corduliine genera, including *Epophthalmia, Didymops, Synthemis, Tetragoneuria, Somatochlora, Cordulia* and *Syncordulia*. It is very unfortunate that the european *Cordulia aenea* also took part of the genus as this gave rise to the opinion of many authors that, according to the rules of nomenclature, the name *Epophthalmia* had to be considered as a pure synonym of *Cordulia* LEACH 1815. Strictly spoken they are right but nevertheless the author has retained BURMEISTER's name *Epophthalmia*, for the following reasons:—

1. The first species described by BURMEISTER under *Epophthalmia* was *vittata*, of the same author.
2. According to HAGEN (Verh. zool. bot. Ges. Wien, 17, 1867) BURMEISTER has personally given to understand that he should like to consider *vittata* as the genotype of *Epophthalmia*. HAGEN (loc. cit., p. 62) writes „Der Gattungsname *Epophthalmia* ist auf den persönlich ausgesprochenen Wunsch Prof. BURMEISTER's seiner *E. vittata* belassen".
3. BRAUER and HAGEN as well as the two monographers of later time i.c. DE SELYS LONGCHAMPS and RÉNE MARTIN have respected BURMEISTER's desire and even at present days the name is in use by several students in *Odonata*.

Thus I think that the only commonsense line to take under this circumstance, is to assume *vittata* to be the real type of *Epophthalmia* and to refer

[1]) From ἐπί upon, and ὀφθαλμός eye. — „Der einzig sichere, beiden Geschlechtern gleichmässig eigene Unterscheidungscharakter dieser in manchen Beziehungen von den ächten Libellen abweichenden Gruppe liegt in der Bildung der Augen, und zwar darin, dass jedes Netzauge an seinem Hinterrande vor den Schläfen einen kleinen Fortsatz aussendet, welcher in die Wange hineintritt, und offenbar die Andeutung eines 2ten Auges ist." (BURMEISTER, l.c., p. 844).

Azuma NEEDHAM (vide postea), a name which had to make its appearance as substitute, to synonymy. This course has been followed in the present paper.

The first more restricted diagnosis of *Epophthalmia* was offered by DE SELYS in the "Synopsis des Cordulines" (1871). In that work it still figured as a subgenus of *Macromia* RAMBUR, and contained two groups, the nearctic *E. taeniolata* RAMB., being the only representative of the first group, and the oriental *vittata,* the type of the second group, including also the other true members of the genus known at that time. In the 2nd Additions to the Synopsis (1878) a second North American species was added to the first group, viz. *georgina* SELYS. On a later place in the same work DE SELYS altered his views to a certain extent in placing *E. elegans* BRAUER with *georgina* in the *taeniolata*-group, leaving all other true *Epophthalmia*'s in the first group of *vittata.* Not to mention other more fundamental marks of identification both groups were characterized in having cross-veins in the triangles of all wings, whereas *amphigena* — also considered to be a *Epophthalmia* with some doubt — appeared in a special paragraph and was defined in having the triangles of the front wings traversed, those of the hind pair being free.

This new arrangement did not give much satisfaction, even not to DE SELYS himself, as is obvious from his remarks on the subject.

Then mention should be made of an interesting report on Corduliine larvae, I mean the third part of LOUIS CABOT's fine work "The Immature State of the Odonata", subfam. Cordulina, published in the Memoirs of the Museum of Comparative Zoology at Cambridge, U.S.A., 1890. This paper is of special interest as it deals with the larva of one of our species, undoubtedly to be referred to *elegans* though CABOT only placed it in the genus *Epophthalmia* with some doubt, according to the fact that these nymphs shew conspicuously spotted wings which rather let him suppose they might belong to *Chlorogomphus.* Yet CABOT was quite right in placing these larvae close to *Macromia.* (NEEDHAM and other authors have shown that spotted wings may occur in many Libellulid genera during larval life, whereas in the adult stage of such genera the wings are hyaline). It may be remembered that CABOT was the first who saw that all nearctic species previously referred to the genus *Epophthalmia* are true *Macromia*'s; this consideration was based upon characters found in a rather large number of larvae from different habitat. MARTIN, in his monograph of the Corduliinae, Cat. Coll. SELYS (1906), however, gave nothing more than a true reflection of his great informant's ideas. Some fifteen years went over before NEEDHAM published his interesting paper on "New Dragon-fly Nymphs in the United States National Museum", in the Proc. U.S.Nat.Mus., vol. 27, 1904. On page 698 of that paper the larva of *E. elegans* was again discussed, but of more interest are NEEDHAM's remarks on the adult insect. Here a new genus was created to contain the large chino-japanese species. The author's arguments in doing so may be quoted *verbatim:*—

> "This species differs from the more typical species of *Epophthalmia* by characters which I believe will be regarded as justifying its generic

separation. Aside from its huge stature, its singular color pattern, its unusual proportions in length of male abdominal appendages, and its smaller number of cubito- anal cross veins, it has three other characters in contradistinction to the more typical species of *Epophthalmia* that I regard of generic importance: (1) Its cubital vein where it borders the subtriangle is straight and strong; in the others it is weak and angulate. (2) Its radial sector is gently and regularly curved; in the others it is broken and distinctly ajog opposite the distal end of the radial supplement. (3) Its ninth abdominal segment in the male bears above a truncated cone; in the others it bears two basal denticles.— Since this is the largest and one of the most peculiar members of the fauna of the Land of the Dragonfly, I would suggest as an appropriate name for a new genus to contain it the classical Japanese name *Azuma*".

In a next to mention paper of WILLIAMSON, the wing-photographs of *elegans* and ? *vittata vittata,* reproduced on page 370 and 371 of it, show at a glance that the above enumerated neural differences as given by NEEDHAM are rather imaginary, and after consulting the material itself the characters proved to be greatly liable to vary. When comparing figs. 1 and 2, I note the following:—

sub (1) In both species the cubital vein where it borders the subtriangle in front wing is angulate and as can be observed in set specimens, there is but very slight difference in the strength of this vein [In my specimens of *E. vittigera* the last named difference is not perceivable at all and in a male and female of *elegans* from Formosa the cubital vein where it borders the subtriangle in front wing is even more angulate than in other species of the genus].

sub (2) The radial sector is almost exactly similar [In my examples of *vittigera* however, I must admit that this vein appears slightly broken towards its apex, but, so far as I am aware, its course is not different].

The third mark of distinction between *Azuma* and *Epophthalmia* (mentioned *sub* (3), *antea*) is, I think, of even less importance than the other ones. Moreover it was found to be variable within the limits of each species, especially in *vittata* and *vittigera*. Hence I propose to withdraw the name *Azuma*.

As already hinted at above, WILLIAMSON's splendid paper "The North American Dragonflies (Odonata) of the genus Macromia" (Proc.U.S.Nat.Mus., 37, 1909) deals also with *Epophthalmia*. In defining the genus *versus Macromia* he writes:—

"They are separated at once from *Macromia,* among other characters, by the greatly developed genital hamules in the male and by several venational characters, among which may be mentioned the abrupt apical curving of *M3* and *M4* in both front and hind wings, and the posterior widening of the hind wing from the anal angle to the termination of *M4*. (See figs. 1, 2.) Venational differences between *Azuma* and *Epophthalmia* are slight and are mainly to be found in the relations of *Cu* and *A* in the front wing proximal to the triangle. The crossed or uncrossed condition of triangles

and subtriangles, which has been used in the past in distinguishing *Macromia* and *Epophthalmia* has no value here as a generic character." [1])

WILLIAMSON's note on the genital hamule in the males seems especially worth attention as the structure of this organ offers a valuable point of distinction between the two genera.

In MARTIN's "Clé pour la détermination des Genres de *Macromini*" (recte *Macromiini*) in his work on the Corduliinae in WYTSMAN's Genera Insectorum (Gen. Ins., Subfam. Cordulinae, Bruxelles, 1914, p. 23), the previous abandoned system in defining the genera was again followed, even in separating *Macromia* from *Azuma-Epophthalmia*, thus neglecting the better characters suggested by WILLIAMSON some five years earlier. In the same key North America is given as a habitat for NEEDHAM's genus *Azuma*. This, of course, is a mistake.

In 1916 RIS (Supplementa Entomologica, 5, p. 71) already stated that the differential characters on which *Azuma* was based are insufficient but at the same time, according to the rules of nomenclature, he applies that name to all the species previously united under *Epophthalmia* sensu WILLIAMSONi 1909.

In the present paper the name *Epophthalmia* is adopted for reasons quoted above.

The last summarizing treatise to be mentioned on the subject is that of FRASER in the tenth part of his "Indian Dragonflies" (Journ. Bombay N. H. Soc., 1921, pp. 673—691), dealing with the Indian representatives of the subfamily. Here again *Macromia* and *Epophthalmia* are separated from each other by the neural characters as given by NEEDHAM and MARTIN, but the diagnosis of the genus is very full, giving a good idea of its appearance though many of the characters given are, of course, also applicable to *Macromia*.

Since the date of WILLIAMSON's work no further changes have been made in the composition of the genus. [2])

Genus EPOPHTHALMIA BURMEISTER.

1839 BURMEISTER Handb.Entom., 2, p. 844 (pars).
1867 HAGEN Zool.Bot.Ges.Wien, 17, p. 59, 62.
1871 SELYS Synopsis d.Cordulines, p. 89 sep. (pars).
1878 SELYS 2me Add.Syn.Cord., pp. 31-32 sep. (pars).
1890 CABOT Mem.Mus.Comp.Zool., 17, 1, pp. 9-11, Pl. 1 fig. 1 (larva *elegans*).
1904 NEEDHAM Proc.U.S.Nat.Mus., 27, p. 698 (imago et larva *elegans*, sub *Azuma*).
1906 MARTIN Cat.Coll. SELYS, 17, Cordulines, p. 57 (key; pars).
1908 NEEDHAM Ann.Ent.Soc.Amer., 1, 4, p. 278 (key; *Azuma* versus *E.*).

[1]) In NEEDHAM's 'Key to the genera of the Corduliinae of the World, based on venational characters', in his paper "Critical Notes on the Classification of the Corduliinae" (Ann.Ent.Soc. Amer., I, 4, 1908, p. 278), the two genera where separated from each other by the last mentioned character only. The distinction between *Azuma* and *Epophthalmia*, as given in this paper was based on the different shape of the vein *Cu* where it bounds the subtriangle in the forewing.

[2]) Just as this paper was going to the press to be printed off, Mr. E. B. WILLIAMSON of the University of Michigan, Ann Arbor, in a recent letter dated 23th March, kindly informs me that NEEDHAM's generic name *Azuma* is preoccupied by *Azuma* JORDAN & SNYDER, for a Japanese fish genus.

1908 WILLIAMSON Ent.News, Philad., pp. 429-430 (key; *Macromiini*).
1909 WILLIAMSON Proc.U.S.Nat.Mus., 37, p. 369, fig. 1-2 (wings *elegans*, ?*vittata*).
1914 MARTIN Gen.Ins., Cordul., p. 23 (key; *Azuma* versus *E.*), pp. 25-26.
1916 RIS Supplem.Entom., 5, p. 71 (*Azuma* versus *E.*).
1921 FRASER Journ. Bombay N. H. Soc., p. 674 (key), pp. 677-678.

Corduliine dragonflies of very large size with an alternated colour-design of reddish to dark brown with metallic green or blue reflex and bright yellow or more quiet stripes and spots. Head large and globular with eyes very bulky, more tranversely placed than in the long axis of the body, not especially contiguous. Eyes in fully mature insects brilliant green above, olivish to grayish blue beneath. Mouth parts and face reddish or dark brown to almost black, usually spotted with yellow but sometimes unicolorous. Frons without sharply indicated anterior border, its upper portion divided into two at least slightly flattened parts, suture rather deep; coloration usually metallic green or blue, whether or not spotted with yellow. Epicranium small with two rather pointed elevations. Occipital triangle rather long, much protruding in front, glossy black. Occiput glossy black with an indistinct large brownish spot on each side against the sinuous projection at posterior margin of the eye.

Synthorax very bulky and of robust size, reddish or dark brown with slight to very brilliant metallic lustre. Antehumeral band of yellow always present, at least occupying the lower half of mesepisternum. Sides at least with complete yellow fascia running to level of coxae and covering the stigma. Thorax brown underneath, whether or not spotted with yellow. Legs long and robust, for the most part black; fore tibia of male with a yellow keel on the flexor surface, occupying the distal half to $5/8$; middle tibia with keel occupying the distal $4/5$-$5/6$; hind tibia with keel extending from near the base to the apex (from $7/8$-$9/10$ of the total length) [1]. Tarsal claws with strong hooks, of about the same size as the claws but slightly enlarged at base, claws thus appearing bifid at end.

Wings long and tapering rapidly towards the apex which is much pointed. Basal portion of hind wing from the anal angle to the termination of *M4* very considerably widened posteriorly, especially in the male; tornus produced and strongly angulated in male but never acute. Wings hyaline, in young females the tips of front wings to proximal side of pterostigma pale yellow (*vittigera*), or all tips indistinctly yellowish; in mature females the whole surface of all four frequently more or less golden yellow and in old specimens very often heavily clouded with brownish. In the male the anal field of hind wing very regularly tinted with pale yellow. Extreme base of hind wings in both sexes often heavily spotted with yellow or dark brown. Pterostigma short and narrow, black. Membranula long and rather broad, usually dark grayish in colour, its distal end darkened, extending from base to end of anal triangle or slightly before or beyond, its distal end, after a slight widening, rather abruptly narrowed towards the wing border. Anal triangle very long and narrow, two-celled.

[1]) In this respect no specific differences could be traced.

Number of antenodal and postnodal cross-veins variable, at least 14 antenodals in front wing, 9 in hind wing.

Anal loop well-developed, rather rounded in general outline, always wider than long, never reaching distal end of triangle and containing at least six cells (usually more), *M4* and *Cu1* in front wing widely divergent in their distal course. Two or rarely three rows of cells in the discoidal field before the forking of *M1-3*. *Cu1* and *Cu2* strongly curved towards the wing border; *M3* and *M4* likewise but with a still more abrupt apical curving towards the margin, these veins running closely parallel to each other in all wings. Arculus between first and second antenodal nervure, its sectors distinctly stalked. Veins *M2* and *Rs* slightly undulated or nearly straight as also the radial supplement. Median supplement absent. — Proximal angle of subtriangle in front wings distal to the level of arculus by at least the length of the interior side of subtriangle. Triangle of hind wing distal to the level of arculus for about the same length as its proximal side. Triangles long and narrow, costal side in front wing at most half as long as distal side, usually shorter, all of them traversed by at least one cross-vein. Subtriangles in front wing generally of about equal width as triangles, proximal side very irregular (in *elegans* usually more regular, but it was never found to be perfectly straight), always traversed by at least one cross-vein. Supratriangles traversed once or more.

Abdomen long, subcylindrical, of about the same length as the wings or longer (incl. anal appendages).

First two segments of male much inflated in dorso-ventral, moderately in lateral dimension; tumidity of distal end of abdomen usually less striking, variable. Segment 3 of male more or less constricted before the middle, thence gradually widening or nearly parallel-sided to segment 8, 9 or 10, the intervening segments either slim and cylindrical, or (*elegans*) rather flattened and widened. Abdomen of female long and cylindrical but rather compressed laterally and — with the exception of the basal segments — usually parallel-sided throughout. Colour usually dark brown or velvet-black, with proximal segments often polished but sometimes more or less ferruginous, generally with bright yellow or orangish bands or spots. Auriculae on second segment of male very small, knob-like, simple.

Genital lobe large, of very characteristic shape: projecting markedly from the ventral surface, almost quadrate and broadly truncated, each bent inwards to meet its fellow on the opposite side so as to enclose like a purse the distal portion of the posterior hamuli, which in their distal ends are closely approximated. Posterior hamuli foliate and much depressed, rather thick at base, each strongly ridged laterally and with a rather deep triangular furrow; distal portion rapidly tapering, its ventral margin strongly arcuate, directed ventrad, ending in a fine more or less circularly curved hook [1]).

[1]) Specific differences in the shape of the posterior hamuli as well as in that of the penis could not be traced, both organs being of very uniform build in all the species examined, and thus appear without value in separating the species.

Basal joint of penis with a pair of very blunt lateral protuberances near the distal end; second joint about three times as long as thick, very slightly curved at base, hardly enlarging towards its end, with a conspicuous dorsal hook followed by a transverse depression which is covered with a very regular mass of transversely arranged striae, radiating on the sides. Third joint about half as long as second, sharply bent at base, subtriangular in profile with a moderate concavity on extensor, a triangular convexity on flexor surface; glans small, membranous, almost hyaline except for a thickly pigmented median crest; distal lobes three in number, the two lateral lobes small and rounded, not sharply separated from the median lobe; this large, bearing a very long and slender cornua which at end divides into two or three very stiff and exceedingly long thread-like processes, which appear spirally twisted in natural position (fig. 1).

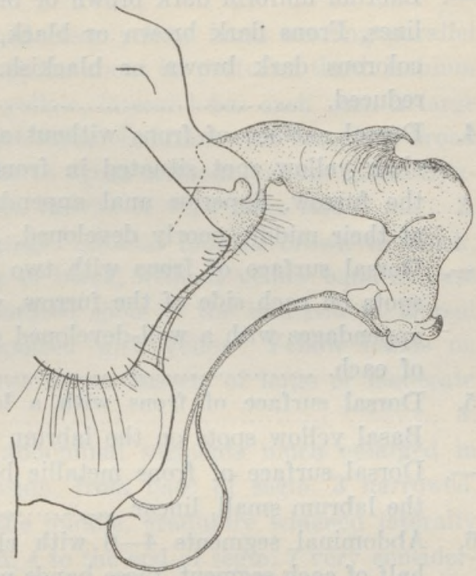


Fig. 1. *E.vittata sundana* LIEFTINCK, ♂. Right lateral view of penis, drawn from freshly captured specimen.

Superior anal appendages of male small, about as long as or slightly longer than tenth abdominal segment, robust and more or less angulated, usually with an extero-lateral protuberance beyond the middle, then rather tapering and more or less inwardly curved with rounded or pointed apex. Inferior appendage triangular, curving upwards more or less to meet the superiors, its apex slightly notched.

Vulvar lamina bilobed, of variable length but never more than half as long as ninth tergite. Ninth sternite extraordinary enlarged, plate-like, flattened or with a sharp median crest at base, about as long as or slightly longer than the tenth tergite, with or without small knobs. Appendages very short, conical.

Genotype: *E. vittata* BURM.

Key to male species.

1. Labium and metepimerum of synthorax partly yellow. .... 2.
—. Labium and metepimerum of synthorax reddish- to dark brown, unicolorous. .... 3.
2. Abdominal segment 6 with two mid-dorsal spots of yellow. Superior anal appendages rather rounded at tip. .... **elegans** (BRAU.).
—. Abdominal segment 6 without yellow spots on dorsum. Superior anal appendages acutely pointed at their tips. .... **elegans**, subspec.?

3. Labrum with clear or pale yellow markings. Frons at least with a yellow point on either side on its anterior surface. Abdominal segment 8 with yellow markings at its base. Insects with rich yellow or orangish coloration ... 4.
—. Labrum uniform dark brown or black, without yellow or whitish spots or lines. Frons dark brown or black, unmarked. Abdominal segment 8 unicolorous dark brown or blackish. Insects with yellow coloration much reduced. .... 7.
4. Dorsal surface of frons without any yellow markings, or with only one clear yellow spot situated in front of the median ocellus and filling up the furrow. Superior anal appendages of male with extero-lateral tooth at their middle poorly developed. .... 5.
—. Dorsal surface of frons with two large widely separated squarish yellow spots on each side of the furrow, which itself is unmarked. Superior anal appendages with a well-developed extero-lateral tooth at about the middle of each. .... **frontalis** SELYS [1]).
5. Dorsal surface of frons with a large, unpaired median spot of yellow. Basal yellow spots on the labrum well-marked, rather rounded. .... 6.
—. Dorsal surface of frons metallic blue, unicolorous. Basal yellow spots on the labrum small, linear. .... **vittata cyanocephala** HAGEN.
6. Abdominal segments 4—6 with clear yellow rings, occupying the basal half of each segment, these bands not sharply defined behind. Superior anal appendages, viewed from side, with their upper margin very slightly convex. Insect of large size: abd. + app. 57, hw. 51-52 mm. .... **vittata vittata** BURM.
—. Abdominal segments 4—6 with much narrower yellow rings, not extending to the base of each segment, occupying from $^1/_5$-$^1/_6$ of the length of these segments. Superior anal appendages, viewed from side, with their upper margin slightly but decidedly concave. Insect of smaller size: abd. + app. 52-54, hw. 47-49 mm. .... **vittata sundana,** ssp.n.
7. Postclypeus uniform dark brown. Antehumeral band of yellow incomplete above, occupying the lower half of mesepisternum. Wing-bases entirely hyaline. Abdominal segment 7 with a yellow marking occupying one-third of the dorsum. Distal third of superior anal apps. not abruptly inwardly bent. Insect of smaller size, abdomen incl. apps. at most 55 mm long. ...... **australis** HAGEN.
—. Postclypeus with pale yellow or whitish lines. Antehumeral band of yellow almost complete, extending at least beyond half the length of mesepisternum. Extreme base of hind wings marked with dark spots at least in costal field. At most a narrow ring of yellow on abdominal segment 7. Distal third of superior anal apps. abruptly inwardly bent. Insect of large size, abdomen incl. apps. 56-59½ mm long. .... **vittigera** (RAMB.).

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[1]) References to other members of the group of *E. frontalis* SEL. are made in the tabular description or under the heading of that species furtheron in the text.

TABULAR DESCRIPTION OF SPECIES.

Males.

1. Metepimerum with a sharply defined clear yellow band running parallel to the second lateral suture and occupying about its posterior third. Labium black, median lobe almost entirely yellow, lateral lobes each with a large rounded or subtriangular yellow spot aside. Labrum with complete broad yellow band at base. Dorsal surface of frons without yellow spots. Synthorax with very broad yellow bands. Insects of very large size. .... 2.

—. Metepimerum without yellow markings. Labium reddish brown to black, without yellow spots. Labrum brown or black, without yellow band at base but sometimes with two widely separated spots of the said colour. Dorsal surface of frons whether or not spotted with yellow. Yellow bands on synthorax narrower, sometimes almost linear. Insects of large or moderate size. .... 3.

2. Abdomen very robust, with basal abdominal segments much enlarged in dorso-ventral, less in lateral dimension, from base of segm. 3 narrowed, this segment rather constricted in the middle, gradually widened laterally towards its end. Abdomen from segm. 4 to the end of segm. 7 very considerably widened (width of segm. 4 at base 2.5, of segm. 7 at end 5.8 mm), from middle of segm. 6 to end of 9 flattened and rather high, then segm. 8 only very slightly, 9—10 very considerably narrowed to the end. Segm. 6 with two mid-dorsal squarish or somewhat rounded, bright yellow spots, separated from each other by the longitudinal carina; these spots not extending onto the sides of the segment. Segm. 7 with a bright yellow ring, occupying slightly less than its basal half on the dorsum, this band with its posterior transverse limit trilobed, the middle lobe triangularly projecting behind. Segm. 8 black with narrow yellow transverse band at base widening along the median line and pointed behind. Anal appendages small, the superiors comparatively thick and robust, each of them distinctly bent inward after the middle, distal half tapering. Extero-lateral tubercle well-developed.

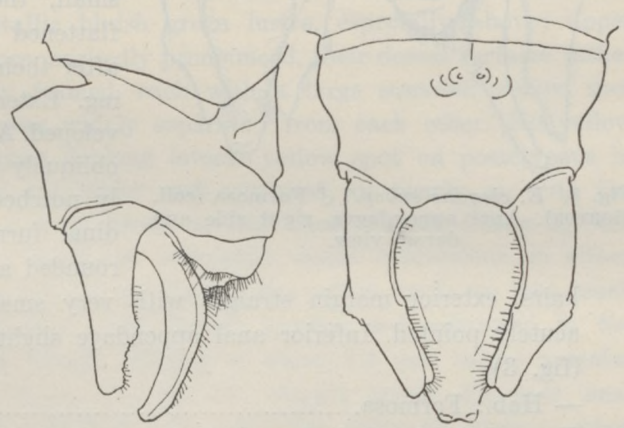

Fig. 2. *E. elegans* BRAUER, ♂ Japan (Mus. Brussels). Anal appendages, right side and dorsal view.

Apex blunt, obliquely truncated interiorly, and, when viewed from above very slightly notched by a longitudinal furrow dividing it into two portions, the intero-ventral portion being rounded and closely beset with strong black hairs, the somewhat larger extero-dorsal portion slightly angulated and almost bare at tip. Inferior anal appendage as long as upper pair, but sometimes either very slightly shorter or distinctly longer (fig. 2). — Hab.: Japan, China, Formosa. .... **elegans** (BRAUER).

—. Abdomen less robust, with basal abdominal segments much enlarged in dorso-ventral, less in lateral dimension, from base of segm. 3 narrowed, this segment only very slightly constricted in the middle, hardly widening laterally towards its end. Abdomen from segm. 4 to the middle of segm. 6 with parallel sides, almost cylindrical, from the middle of segm. 6 to the end of 7 distinctly widened (width of segm. 4 at base 2.4, of segm. 7 at end 4.4 mm). Terminal segments slightly and gradually narrowed, 7—9 higher and less flattened than in the preceding species. Segm. 6 entirely black above and aside; on the ventral portion of the tergites two reddish brown spots at base; 7 with a bright yellow ring occupying slightly less than its basal half on dorsum and with its posterior transverse limit straight, not projecting in the middle. Segm. 8 black with very narrow transverse yellow line at base scarcely protruding behind. Anal appendages small, the superiors slender, more flattened and less inwardly curved after their middle; distal half tapering. Extero-lateral tubercle well-developed. Apex, when seen from above, obliquely truncated interiorly, scarcely notched by a very short longitudinal furrow; intero-ventral margin rounded and beset with strong black hairs, exterior margin straight with very small irregular tubercles, tips acutely pointed. Inferior anal appendage slightly longer than upper pair (fig. 3).

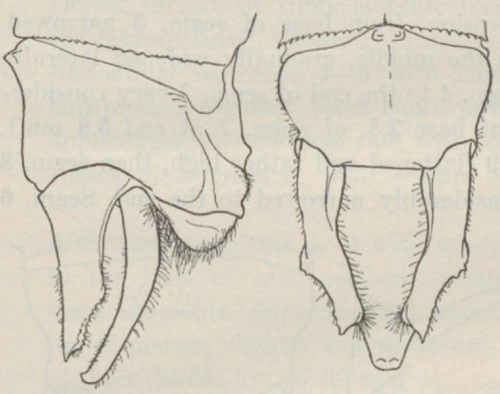

Fig. 3. *E. elegans subsp.*? ♂ Formosa (coll. MORTON). Anal appendages, right side and dorsal view.

— Hab.: Formosa. .... **elegans**, subspec. ?

3. Frons light to dark brown. Labrum with clear yellow or pale yellow markings. Vertical and dorsal surfaces of frons either marked with clear yellow spots or (*vittata cyanocephala*) with a yellow point only on either side on its anterior surface. Postclypeus with broad basal band of yellow, often interrupted in the middle line. Antehumeral and lateral thoracic bands rather broad, clear yellow. Transverse yellow rings on dorsum of abdominal segments 2—6 conspicuous, at least part of them complete, sometimes almost occupying the basal half of the segments. Terminal segments 8—10

and anal appendages either almost entirely ferruginous or reddish- to dark brown with yellow markings at least on base of segm. 8 .... 4.

—. Face black or very dark brown. Labrum uniform dark brown or black without yellow or whitish spots. Frons dark brown or black with bright metallic reflex, but without any yellow markings. Postclypeus unmarked or with only small pale aqueous-yellow spots or lines. Antehumeral band either reduced and only occupying the ventral portion of mesepisternum, or complete; in both cases narrow and usually of a dull yellow colour. Transverse marks on dorsum of abdominal segments 2—6 narrow, incomplete (paired), less intensively coloured, sometimes reduced to mere traces. Terminal segments 8—10 and anal appendages very dark brown or black, unicolorous. .... 8.

4. Frons with bright metallic green or bluish green lustre, especially above; upper margins of tubercles rather irregularly rounded in front and towards the sides. Dorsal surface either entirely unmarked, or with conspicuous subtriangular yellow spot situated just in front of the median ocellus and filling up the deep furrow. Oblong lateral yellow spot on postclypeus in front of the compound eye separated from the main fascia covering the postclypeus. Sides of synthorax in fully adult specimens reddish- to dark russet-brown, with bright metallic green lustre, this reflex deepened along the lateral yellow fascia covering the stigma. Antehumeral band long, almost reaching antealar sinus. Superior anal appendages with extero-lateral tooth at about their middle obsolete, or only poorly developed (figs. 6—8). .... 6.

—. Frons with bright metallic bluish green lustre, especially above; upper margins of tubercles more markedly pronounced, their dorsal surfaces rather more flattened, slightly framed, each with a large squarish yellow spot in the centre; these spots widely separated from each other. No yellow spot filling up the furrow. Oblong lateral yellow spot on postclypeus in front of the compound eye wider and confluent, or nearly so, with the main fascia to form a very broad arched band almost filling up the whole postclypeus; this band not undulated: basal depressions on either side of the median line not brown. Remaining yellow spots on face much as in *vittata*. Antehumeral band slightly curved, not narrowed in the middle, shorter than in *vittata*, ceasing at about 1.5 mm before antealar ridge. Lateral yellow band covering the stigma broad. Superior anal appendages ferruginous with their upper margins distinctly concave when viewed in profile, slightly turned upwards towards the apex, each with a well-developed extero-lateral tooth at about the middle. .... 5.

5. Ground-colour of synthorax chestnut-brown with slight metallic reflex on the dorsum and on each side along the lateral yellow fascia only, the intervening spaces thus being without metallic lustre. Wings long, basal portion of the hinder pair from the anal angle to a level of about end of anal loop considerably widened, after this widening both hind wings regaining

their usual width more abruptly than in the other species. Three rows of cells between the lower boundary-nerve of anal loop (A_2) and the posterior border of hind wing. Anal loop containing 9—10 cells with distinct central cell. A minute brown point in *c* at extreme base of hind wings. Nodal index $\frac{6.14}{9.10.}\Big|\frac{15.7}{10\,9}(\frac{42}{38})$. Abdomen long, as in *vittata vittata* but up till the end of segm. 7 less cylindrical, more rapidly enlarged, segm. 7 distinctly widened towards its apex and from the base of 8 again much narrowed. Dorso-ventral enlargement of last three abdominal segments more pronounced than in *vittata* and its races. Ground-colour of basal abdominal segments reddish brown, from segm. 3 to 6 gradually changing into almost deep black, 7—10 and anal appendages lighter. Complete broad citron-yellow ring on segm. 2, as in *vittata,* 1—1.5 mm wide on mid-dorsum, more than 2 mm across the auricles. Very broad transverse orange yellow band on segm. 3 sharply defined and occupying $^2/_5$ of the segment at dorsum, very broadly joining a latero-ventral fascia running to the antero-basal margin of the segment where it is broadly connected with the lower posterior border of the preceding segment (these markings thus longer than in *vittata vittata*). Similar rather sharply limited yellow rings on segm. 4—6 occupying the basal half of each segment. 7 brownish on dorsum, its basal half ferruginous, this colour badly defined; remaining segments ferruginous, above unsharply limited yellowish. Appendages likewise, unmarked, slightly darker. Superior ones comparatively thick and robust. Inferior appendage slightly longer than upper pair (fig. 4). Length: abd. + app. 54, hw. 48: 16.5, pt. $\frac{>3}{3}$ mm. — Hab.: "Malaisie ?" (possibly India). **frontalis** SELYS.

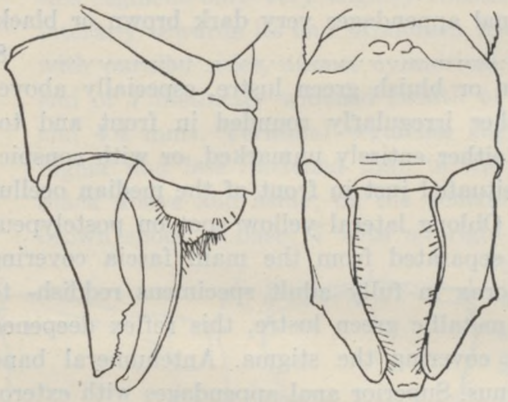

Fig. 4. *E. frontalis* SELYS, ♂ „Malaisie?" (Mus. Brussels), Type. Anal appendages, right side and dorsal view.

—. (Immature male). Ground-colour of synthorax slightly darker with metallic green reflex especially vivid on dorsum and on each side along the lateral yellow fascia, the intervening spaces only having a faint metallic hue. Wings very short, basal portion of hinder pair more evenly widened and no rather abrupt transition between this and the apical part of the wing. Only two rows of cells between A_2 and the posterior border of hind wing. Anal loop narrower, consisting of only very few, 6—7 cells without central cell in left hind wing. A minute brown point in *c* and *sc* at extreme base of hind wings. Nodal index $\frac{6.14.}{8.12.}\Big|\frac{14.6}{10\,8}(\frac{40}{38})$. Pterostigma brown. Abdomen deformed by pressure, with its light markings almost similar to the pre-

ceding species. Ground-colour of segm. 1—6 deep black, of 7 brown, spotted and banded as in *frontalis,* of 8—10 cloudy, somewhat patchy ferruginous, and on dorsum of 8 a subtriangular yellowish streak at base. Appendages yellow, the superiors finely tipped with brown, more slenderly built and slightly more bent inwards after their middle. Inferior appendage distinctly longer than upper pair (fig. 5). Length: abd. + app. 53.5, hw. 54:15, pt. $\frac{\geq 3}{3}$ mm. — Hab.: Assam (Khasia Hills). .... cf. **frontalis** SELYS.

6. Mouth-parts and face reddish- or dark brown with two large basal yellow spots on the labrum; with a rounded spot at base of mandibles; with a sinuous transverse band on postclypeus (sometimes broken into four pieces), and besides, with a lateral oblong yellow spot on postclypeus, close before the eyes. Conspicuous rather rounded clear yellow spots on either side on the vertical portion of frons and a large unpaired median spot of the same colour on the dorsal surface of frons; this mark rounded aside, slightly pointed in front. .... 7.

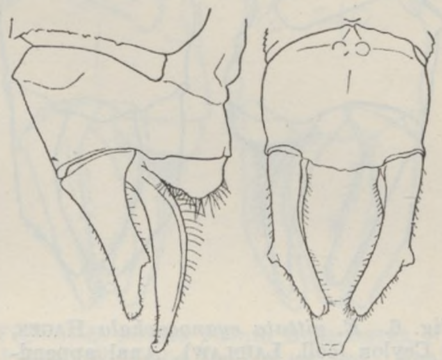

Fig. 5. *E.* cf. *frontalis* SELYS, ♂ Khasia Hills, Assam (Mus. Brussels). Anal appendages, right side and dorsal view.

—. Mouth-parts and face reddish- or dark brown with two small linear basal yellowish spots on the labrum; with a narrow sinuous transverse band on postclypeus, slightly interrupted in the middle line and broadly sinuous on either side of it (caused by two brown basal impressions), and with a lateral oblong spot on postclypeus before the eyes. A almost obsolete yellow point only on each side on the vertical portion of frons. Dorsal surface of same metallic blue without any light markings. Ground-colour of synthorax very dark reddish brown, this colour almost everywhere suffused with brilliant blue metallic lustre. Antehumeral band narrow, almost straight, not interrupted in the middle, gradually tapering to a point above. Lateral yellow band covering the stigma narrow, considerably narrowed below and rather pointed. Abdomen shaped as in the typical race, but decidedly shorter. Ground-colour of abdominal segments black. Complete narrow citron-yellow ring on segm. 2, width of this band at most 1 mm mid-dorsally, at most 2 mm across the auricles. Narrow transverse citron-yellow ring on segm. 3, sharply defined and occupying ¼ of the segment aside, distinctly and triangularly constricted by the dorsal carina; proximal half of latero-ventral margin of same segment narrowly bordered with pale yellow. Yellow rings on segm. 4—5 in front of transverse carina very narrow, not extending to the base of each segment, slightly diffuse in front, occupying about $^1/_6$ on segm. 4, $^1/_4$-$^1/_5$ on segm. 5. These spots

diffusely interrupted in the middle line by the dorsal carina. Segm. 6—7 with complete basal orange yellow rings, occupying about ⅓ or slightly more of these segments respectively.

Segm. 8 with a sharply defined transverse band at base, widest in the middle and not overlapping the sides. Segm. 9 very dark brown, unmarked, passing on the sides into dark ferruginous. Segm. 10 reddish brown on dorsum, on the sides at base partially suffused with yellow and on mid-dorsum again fading to brownish. Anal appendages reddish brown. Inferior appendage rather longer than the superiors (only one specimen examined). Shape of superior appendages almost alike those in the typical race (fig. 6). Insect of large size. Length: abd. + app. 55, hw. 53 : 16, pt. 3.4 mm. — Hab.: Ceylon. ....

vittata cyanocephala HAGEN.

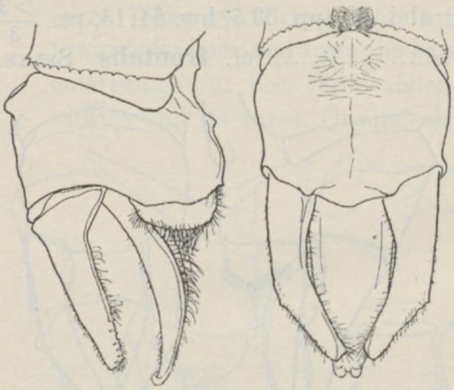

Fig. 6. *E. vittata cyanocephala* **HAGEN, ♂ Ceylon (coll. LAIDLAW). Anal appendages, right side and dorsal view.**

7. Postclypeus with a complete straight or sinuous transverse light yellow band: on either side of the median line this band sometimes encloses two brown points filling up the depressions. Light markings on anterior part of head bright citron-yellow. Ground-colour of synthorax reddish- to dark brown with bright bluish green metallic reflex. Antehumeral band straight or slightly curved, not narrowed in the middle, at least 1 mm broad above. Lateral yellow band covering the stigma broad, rather rounded below. Abdomen long (i.e. segm. 7 about two times as long as broad), up till the end of segm. 7 very gradually enlarged, from the base of segm. 8 again very evenly narrowed. Ground-colour of basal abdominal segments dark brown to reddish brown, as far as segm. 6 inclusive gradually passing into bright ferruginous; segm. 7—10 and appendages bright ochreous, without dark markings (sometimes terminal segments slightly darkened aside). Complete broad citron-yellow ring on segm. 2; width of this band on mid-dorsum 1—1.5 mm, more than 2 mm across the auricles. Broad transverse orange yellow ring on segm. 3, rather sharply defined and occupying ⅓ of the segment at dorsum, not interrupted by the median line, joining a longitudinal fascia of the same colour running along latero-ventral margin to the lower antero-basal margin of the preceding segment, where it is narrowest. Similar but much broader yellow rings on segm. 4—6, occupying the basal half of each segment, these bands not sharply pronounced behind, passing into the ferruginous ground-colour (sometimes the extreme base of segm. 4 diffusely brownish black). Superior anal appendages, viewed from side, with their upper margin very slightly convex and bent downwards towards

the apex, distal half of the appendages thus appearing as lengthening of the proximal part, comparatively more robust than in *vittata sundana*. Inferior appendage as long as or slightly longer than upper pair (fig. 7). Insect of large size. Length: abd. + app. 57, hw. 51-52 : 16, pt. 3.6-4 mm. — Hab. Peninsular India (excl. Ceylon), Thibet, Bengal ....
vittata vittata BURM.

—. Postclypeus with two oblong pale yellow spots on each side at base; middle piece of same brown with two extremely fine arched lines in front of it, pale yellow in colour. Arrangement and number of light markings on anterior part of head the same as in the typical race, but more reduced, those on the face pale yellow. Ground-colour of synthorax very dark reddish brown with rather dark green metallic reflex. Antehumeral band evenly curved, slightly constricted in the middle, rather rounded and at most 0.6 mm broad above. Lateral yellow band covering the stigma narrow, considerably narrowed below and rather pointed. Ground-colour of abdominal segments velvety black, from segm. 9 gradually fading to dark brown; segm. 10 and appendages very dark reddish brown. Abdomen comparatively shorter (e.g. segm. 7 less than two times longer than broad), shaped as in the typical race. Complete, narrow, citron-yellow ring on segm. 2, width of this band on mid-dorsum at most 1 mm, across the auricles at most 2 mm. Narrow transverse citron-yellow ring on segm. 3 sharply defined and occupying ¼ of the segment aside, distinctly and triangularly constricted by the dorsal carina or narrowly separated into two semicircular spots; proximal half of latero-ventral margin of same segment narrowly bordered with pale yellow. Yellow rings on segm. 4—6 in front of transverse carina very narrow, not extending to the base of each segment, slightly diffuse in front, occupying less than $^1/_5$ of segm. 4, almost $^1/_6$ of segm. 5—6. These spots diffusely interrupted in the median line by the dorsal carina. Segm. 7 with a complete basal orange yellow ring, occupying slightly less than ⅓ of the segment, protruding a little behind; this ring often diffusely darkened towards the extreme base of the segment. Segm. 8 with a sharply defined narrow transverse dorsal line at base not extending onto the sides, and often divided into two pieces by the longitudinal carina forming two somewhat diamond-shaped yellow spots. Segm. 9 very dark brown, unmarked. Segm. 10 and appendages reddish brown, slightly darkened above and at base. Superior anal appendages, viewed from side, with their upper margins slightly but distinctly

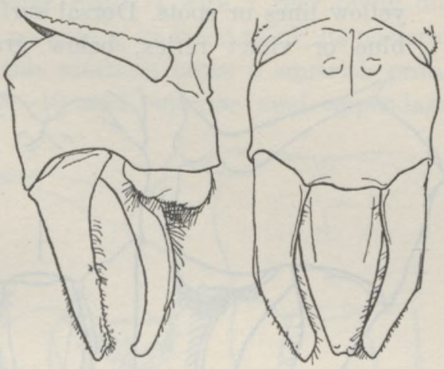

Fig. 7. *E. vittata vittata* BURMEISTER, ♂ Poona, W. India (coll. LAIDLAW). Anal appendages, right side and dorsal view.

concave, this margin very little bent upwards towards the apex, thus distal half of the appendages evenly and slightly curved, rather slender and more pointed than in the typical race. Inferior anal appendage a trace shorter than upper pair (fig. 8). Insect of smaller size. Length: abd. + app. 52-54, hw. 47-49 : 16, pt. 3.4-3.5 mm. — Hab.: Java... **vittata sundana** ssp.n.

8. Mouth-parts and face reddish- to dark brown without any trace of pale yellow lines or spots. Dorsal surface of frons black with brilliant metallic blue or violet reflex, below gradually fading to dark reddish brown. Thorax jet-black with very brilliant metallic green or blue shine, marked with light as follows: — A short *incomplete* straight cuneiform antehumeral band, pale orangish in colour and running obliquely over the mesepisternum extending upwards for half of its height, tapering to a point; below this stripe covers the antero-dorsal half of the mesinfraepisternum, which on its postero-ventral part is reddish brown in colour. Sides with a complete straight, narrow, pale orangish stripe covering the stigma (width at most 1 mm) running along first lateral suture, below almost touching coxae of second pair of legs, above slightly narrowed, not reaching dorsal margin of metepisternum. Dorsal surface of thorax, especially on mesepisternum, covered with long, soft, silvery or golden-yellow hair. Venter reddish brown, rather buff; coxae reddish brown. Legs black, basal ⅔-¾ of exterior sides of fore and middle femora, basal ⅓-½ of hind femora reddish brown. Wings hyaline without brownish spots at extreme base of posterior pair. Pterostigma dark brown, almost black. Nodal index varying between $\frac{47}{41}$ and $\frac{54}{44}$. Abdomen short and of rather compact building, with comparatively short segments, from middle of segm. 3 to the end of 8 gradually enlarged and slightly depressed, then distinctly narrowed towards the end with posterior margin of segm. 10 much narrower than the same margin of segm. 8. Dorso-ventral enlargement of terminal four segments less marked than in *vittigera*. Dorsal surface jet-black, sparsely decorated with dull yellow. Segm. 1 black. Segm. 2 with a very narrow transverse line on dorsum at base, this line slightly widened and rounded behind, not overlapping the sides; these with a thick, comma-shaped dull yellow band running obliquely from the auricles to the base of second sternite, which is reddish brown in colour. Dorsum

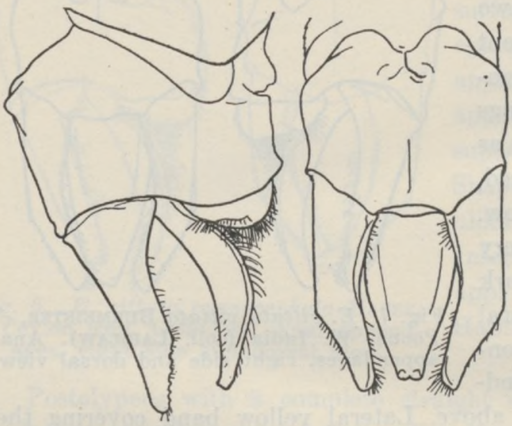

Fig. 8. *E. vittata sundana* LIEFTINCK, ♂ Buitenzorg, Java (Mus. Buitenzorg), Type. Anal appendages, right side and dorsal view.

of segm. 3—4 with small, paired, strongly diamond-shaped orangish spots in front of the transverse carina, occupying about 1/8 of their length. Laterally, after a slight constriction, these spots are confluent with the dull orangish colour on the ventral portion, covering the anterior 2/3 or half of these segments, respectively. Segm. 5—6 with only barely visible orangish lines on dorsum, similarly placed as those on the preceding segments, that on segm. 6 usually absent. Segm. 7 with a very broad dull orangish ring roundabout the segment, occupying its basal third; its posterior margin straight but on mid-dorsum this marking bears a squarish protuberance behind. Dorsum of segm. 8—10 and superior anal appendages unicolorous, velvet-black. There are, besides, extremely narrow yellowish lines behind the articulations of abdominal segments 3—5. Anal appendages, when viewed from above, roughly subtriangular in general outline. Superior ones thick, slightly bent inwards after their middle but apices widely distant, never meeting one another, with a well-developed extero-lateral tubercle slightly behind the middle of each; when seen in profile they appear almost straight, thick at base, gradually narrowed to the end with perfectly rounded apices. Inferior appendage strongly curved, always longer than superior pair, dark reddish brown in colour (fig. 9). Insect of moderate size. Length: abd. + app. 53—55, hw. 49-52 : 14-14.5; pt. $\frac{2.8\text{-}3}{2.6\text{-}2.8}$ mm. Hab.: Celebes and "Moluques". .... **australis** HAGEN.

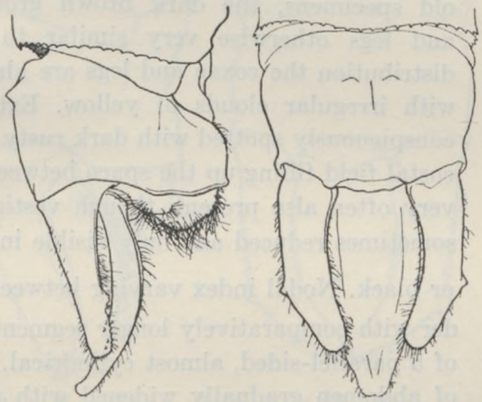

Fig. 9. *E. australis* HAGEN, ♂ Limbotto, Celebes (Mus. Leiden), Type. Anal appendages, right side and dorsal view.

—. Mouth-parts and face reddish- to very dark brown, unmarked excepted postclypeus which is always decorated with pale aquaish-yellow lines as follows:— A mere point on its lateral lobes, at inferior antero-lateral margin, close before margin of the compound eye (present in most of Java and Borneo males but very often absent altogether); a narrow transverse stripe at base, at least interrupted in the middle (Java, Borneo), sometimes broken up into four pieces (Timor, Borneo, Palawan):— the lateral spots largest, slightly oblique, abruptly leaving off before reaching margin of compound eye, the median ones on each side of the middle line arcuate, comma-shaped or linear, edging or filling up the depressions (in the two males from Palawan the four spots much reduced, the median ones vestigial). Dorsal surface of frons black with brilliant green or bluish green reflex, below gradually fading to dark brown. Thorax very dark reddish brown to almost black with brilliant but less intensive metallic shine, marked

with yellow as follows: — A narrow (0.7—0.3 mm), almost complete, slightly curved antehumeral stripe situated as in *australis,* but always extending upwards markedly beyond half the length of mesepisternum, in typical specimens of equal width and ceasing at 1.3 mm before antealar sinus, rounded above — in specimens of eastern habitat reduced and gradually narrowed above, almost linear and ceasing at about 2 mm before antealar sinus. Sides with a complete straight yellow or orangish stripe covering the stigma (1.2—0.6 mm) situated as in *australis,* almost reaching dorsal margin of mesepisternum. Dorsal surface of thorax covered with grayish- or dark brown hair. Metepimerum only moderately metallic, even in very old specimens, the dark brown ground-colour generally visible. Thorax and legs otherwise very similar to *australis;* in specimens of eastern distribution the coxae and legs are almost entirely black. Wings hyaline or with irregular clouds of yellow. Extreme base of posterior pair always conspicuously spotted with dark rusty brown; these spots at least present in costal field filling up the space between base and first antenodal cross-vein, very often also present, though vestigial, in subcostal and median spaces, sometimes reduced and only visible in costal field. Pterostigma dark brown or black. Nodal index varying between $\frac{51}{43}$ and $\frac{56}{48}$ Abdomen lengthy and slender with comparatively longer segments, from middle of segm. 3 to the end of 5 parallel-sided, almost cylindrical, not depressed, from base of 6 to end of abdomen gradually widened with posterior margins of segm. 8 and 10 of almost equal width. Last four abdominal segments more markedly and more abruptly enlarged in dorso-ventral dimension. Dorsal surface either dark brown with a reddish shade (Malacca, Sumatra, Java), or jet-black (Borneo, Palawan, Timor), segm. 2—7 or 2—5 narrowly decorated with more or less sharply defined spots of a dull yellow or orange colour. Segm. 1 blackish, 2 with a rather broad transverse subbasal ring in front of the transverse carina; this band straight on dorsum, largely extending onto the sides, just touching the auricles, then running obliquely downwards to meet base of second sternite, which is brown. On dorsum this band does not reach the base of its segment, being 1—1.5 mm distant from it and about 1 mm wide. Dorsum of 3—5 or 3—4 (Palawan) with small paired diamond-shaped orangish spots in front of the transverse carina, these progressively smaller from before backwards, their respective

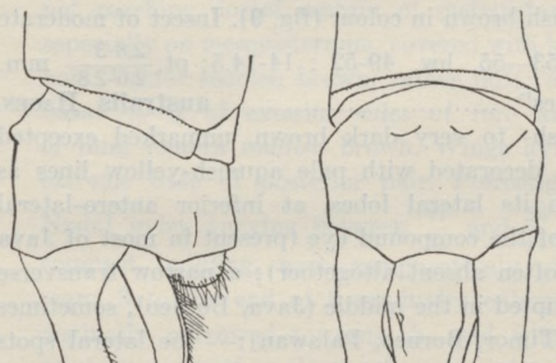

Fig. 10. — *E. vittigera* RAMBUR, ♂ Sintang, Borneo (coll. RIS). Anal appendages, right side and dorsal view (After RIS).

width being about 1—1.2, 0.8, 0.3—0.5 mm (Malacca to Timor), 0.8, 0.4, 0.2 (Borneo), 0.5, 0.3, absent (Palawan). In specimens from Sumatra and Java the spots are confluent with the very dark orange brown colour underneath, as in *australis*, in the other males these segments remain black. Segm. 6 with traces of orangish lines usually absent though still visible in males from Malacca, Sumatra and Java. Segm. 7 in front of the transverse carina either marked with a narrow ring, whether or not interrupted in the middle line (Malacca, Sumatra, Java), or entirely black (Timor, Borneo, Palawan). Dorsum of 8—10 and anal appendages unicolorous, dark reddish brown to velvet-black. Extremely narrow yellowish lines at articulations of basal segments usually absent. Anal appendages, viewed from above, roughly squarish in general outline. Superior ones very thick and robust, at first parallel-sided, their distal one-third very abruptly and strongly bent inwards with a well-developed extero-lateral tubercle; apices strongly inclined to one another and nearly meeting. When seen in profile they appear almost straight, very thick at base, then parallel-sided and lastly, after having given off their tooth, rapidly tapering with apices nearly pointed. Inferior appendage slightly curved, of equal length, dark reddish brown or black (figs. 10—11). Insect of large size. Length: abd. + app. 56—59½, hw. 50-53 : 15-16, pt. $\frac{3\text{-}3.2}{2.7\text{-}3}$ mm. — Hab.: ? Burma, ? Assam, ? Tonkin, Malacca, Sumatra, Java, Borneo, Palawan, Timor. ..... **vittigera** (RAMB).

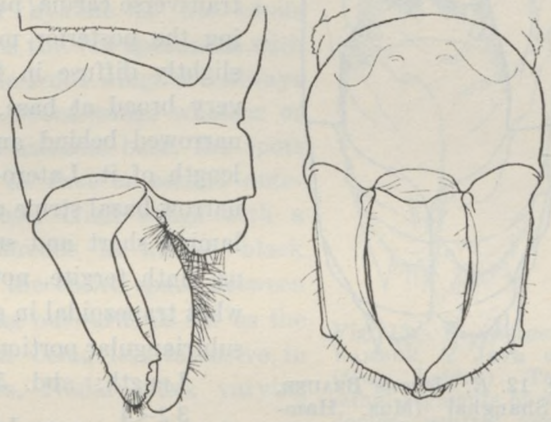

Fig. 11. *E. vittigera* RAMBUR, ♂ Tay Tay, Palawan (coll. MORTON). Anal appendages, right side and dorsal view.

Females [1]).

1. Metepimerum with a sharply defined clear yellow band running parallel to the second lateral suture and occupying its posterior third to fourth. Labium black with its median lobe and a large rounded or subtriangular spot on each side on the lateral lobes bright yellow. Labrum with complete broad yellow band at base. Dorsal surface of frons without yellow spots. Clypeus with a ⊓-shaped basal yellow fascia. Synthorax with very broad

[1]) The females are very insufficiently known. Only four species (including one subspecies) could be arranged in a key. Apart from this, the female of *E. vittata cyanocephala* has been very briefly characterized by LAIDLAW (1924), but I am unable to separate it from typical *vittata* from the description only.

yellow bands. Wings hyaline with pale basal yellow spot in costal and subcostal spaces extending to about first antenodal cross-vein and with their apical ⅓-¼ portion also of a pale yellow colour. Nodal index low, varying between $\frac{43}{39} - \frac{49}{44}$. Basal portion of hind wing comparatively narrow. Abdomen stout, subcylindrical, terminal segments much flattened in dorso-ventral dimension. Black, segm. 2—3 with broad orange rings similar to those in the male, 4—7 with very large squarish dorsal marks in front of the transverse carina, partly occupying the sides, touching the posterior margin of preceding segment or slightly diffuse in front, the marking on segm. 7 very broad at base, encircling the whole segment, narrowed behind and occupying almost ¾ of the length of it. Latero-ventral margin of 8—9 and a narrow basal stripe on dorsum of 8 orangish. Vulvar lamina short and small, about one fourth as long as ninth tergite, not projecting downwards, somewhat trapezoidal in general outline, divided into two subtriangular portions by a shallow incision (fig. 12).

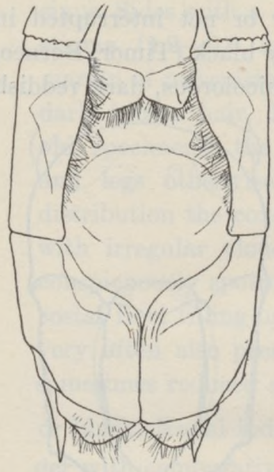
Fig. 12. *E. elegans* BRAUER, ♀ Shanghai (Mus. Hamburg). Terminal segments of abdomen, ventral view.

Length: abd. 57-62, hw. 52½-54 : 14-14½, pt. $\frac{3.2\text{-}<4}{3.0\text{-}3.8}$ mm. Insect of very large size. ....
elegans (BRAUER).

—. Metepimerum without yellow markings. Labium reddish- to dark brown without yellow spots. Labrum light or dark brown without complete yellow fascia at base, sometimes spotted with pale yellow. Clypeus with incomplete narrow yellow lines at base or unmarked. Dorsal surface of frons whether or not spotted with yellow. Yellow bands on synthorax narrower, sometimes almost linear. Vulvar lamina conspicuous, slightly or not projecting, always divided into two leaf-like lobes. Insects of large or moderate size. .... 2.

2. Mouth-parts and face reddish to dark brown with at least traces of two subtriangular basal yellowish spots on the labrum; with a narrow sinuous transverse band on postclypeus sometimes reduced and broken into four pieces, or almost entirely absent; lastly, with an oblong bright spot at margin of lateral lobes, before the eyes. Conspicuous rather rounded clear yellow spots on each side on the vertical portion of frons and an unpaired median spot of the same colour, filling up the furrow, on dorsal surface of same. This spot usually rounded aside and slightly pointed in front (*vittata vittata*), though sometimes vestigial or even absent altogether (*vittata sundana*). Wings hyaline with small yellow or brown spots at extreme base and with apices sometimes yellowish enfumed. Yellow markings on abdomen similar to the male but less sharply defined. .... 3.

—. Mouth-parts and face reddish- to dark brown, unmarked excepted postclypeus which is always decorated with pale aquaish-yellow lines as in male. Frons unmarked, its dorsal surface with green or bluish green metallic reflex less intensive than in the male, below fading to reddish- or dark brown. Light markings on thorax and abdomen very similar to the male but in most cases rather broader and less sharply defined. Metallic shine on thorax less brilliant, the dark ground-colour generally being predominant. Wings either hyaline or the whole surface with a dirty ochreous tint (In specimens with hyaline wings the tips of the front wings are always clouded with pale yellow). Front wings whether or not spotted with brown at extreme base, the spots extending outwards as far as first or second antenodal nervure, rather diffuse. Hind wings with a very conspicuous dark ochreous to almost black marking at base filling up the entire space between costa and $R + M$, extending outwards as far as the *third cross vein,* this colour being less intensive in median and cubital spaces. Nodal index varying between $\frac{50}{41} - \frac{58}{49}$. Abdominal segments 3—6 with narrow, paired, transverse yellow spots in front of the transverse carina, these spots progressively smaller from before backwards, those on segm. 6 very small. Segm. 7 with similarly placed triangular yellow mark on dorsum which is pointed in front and connected with the posterior margin of preceding segment, its lateral transverse offshoot being also pointed. Remaining segments unmarked excepted sternites, which are brown. In specimens with heavily tinted wings (probably all very adult females) the light markings on thorax and abdomen are much darkened and badly defined. Vulvar lamina not or only slightly projecting, each of the lobes circular or ovate with completely rounded tips (figs. 13—14). Length: abd. 57-60, hw. 53-55 : 14½, pt. $\frac{>3}{3} - \frac{3.2}{3.1}$ mm. Insect of large size

vittigera (RAMB).

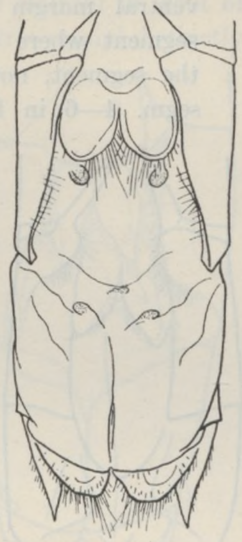

Fig. 13. *E. vittigera* RAMBUR, ♀ Java or. (Mus. Leiden). Terminal segments of abdomen, ventral view.

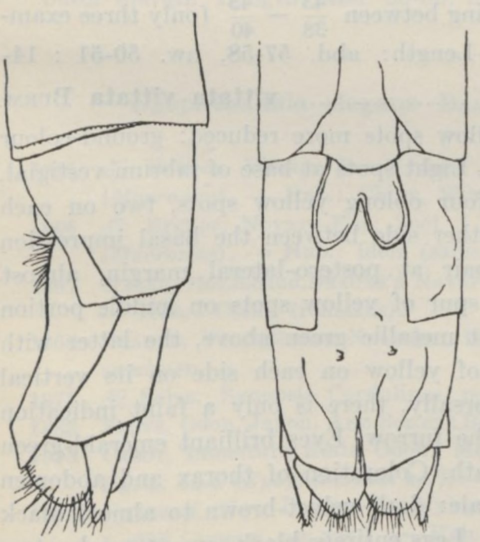

Fig. 14. *E. vittigera* RAMBUR, ♀ Sintang, Borneo (coll. RIS). Terminal segments of abdomen, left side and ventral view (After RIS).

3. Head as in the male, dark colours much paler. Yellow ring in front of transverse carina on third abdominal segment continuous along latero-ventral margin of the tergite, meeting posterior border of preceding segment where it is narrowed to almost pointed, occupying ¼-⅓ of the segment, not indented in front by the median line. Light rings on segm. 4—6 in front of transverse carina fairly large, sharply defined posteriorly, their anterior portions indistinct, largely replaced by the brown ground-colour and occupying ⅓-¼ of the segments. Basal ⅓-⅖ of segm. 7 in front of transverse carina with a dull ochreous ring, pointed and extending slightly beyond carina behind. Segm. 8 with two small dorsal spots of the same colour on each side at base. Remaining segments dark russet, unmarked. Vulvar lamina slightly projecting downwards, divided into two oblong somewhat obliquely placed leaf-like lobes, each about half as long as ninth tergite, obtusely pointed (fig. 15).

Fig. 15. *E. vittata vittata* BURMEISTER, ♀ Bengal (Mus. Brussels). Allotype. Terminal segments of abdomen, ventral view. Segm. 9-10 strongly bent downwards; appendages broken.

Wings hyaline, apices of front pair sometimes evenly clouded with pale yellow. Extreme base of hind wings with a small orangish or brown spot between costa and $R + M$ only, extending outwards as far as *first antenodal cross vein*, sometimes median and cubital spaces also yellowish, in one adult specimen (Bengal) the extreme bases of all four wings being diffusely ochreous brown. Nodal index varying between $\frac{43}{38} - \frac{43}{40}$ (only three examples examined). Length: abd. 57-58, hw. 50-51 : 14-14.5, pt. $\frac{3.5}{3.4}$ mm. .... **vittata vittata** BURM.

—. Head much as in the male but yellow spots more reduced: ground-colour almost uniform dark reddish brown. Light spots at base of labrum vestigial, pale yellowish. Postclypeus with four oblong yellow spots, two on each side, the upper pair situated on either side between the basal impression and the eye-margin, the lower pair at postero-lateral margin, almost touching margin of eye; hence no spur of yellow spots on middle portion of clypeus. Vertex and frons bright metallic green above, the latter with a well-defined subtriangular spot of yellow on each side on its vertical surface, before eye-margin, but, dorsally, there is only a faint indication of a light median spot filling up the furrow. Eyes brilliant emerald-green during life, golden-brown after death. Coloration of thorax and abdomen strikingly similar to that of the male: dark velvet-brown to almost black with metallic green shine on thorax. Legs entirely black, except trochanters which are brown. Abdomen slender, again very similar in shape and size to the male, with its basal segments slightly more swollen, thus giving it a more distinct spindle-shaped appearance. Light markings all narrower

than in the typical race though a trace enlarged when compared with the male, clear citron-yellow on segm. 2—4, thence gradually a little darker, bright ferruginous. Yellow ring around third abdominal segment in front of transverse carina much as in *vittata vittata*, though narrower and distinctly indented to almost separated in front by the longitudinal carina. Well defined rings roundabout segm. 4—6 rather narrow, exactly similar to those in the male, sharply limited posteriorly and below just touching hind margin of preceding segment. Remaining segments as in the typical race. Vulvar lamina slightly projecting, divided into two oblong obliquely placed leaf-like lobes, their distal portion being narrower than in *vittata vittata* and decidedly pointed (fig. 16). Wings entirely hyaline except extreme base of posterior pair which are pale yellowish. A sharply pronounced reddish brown to black spot between costa and $R + M$, in *c* extending outwards as far as *first antenodal cross vein* or a spur beyond, in *sc* to nearly half-way first and second cross-vein. Nodal index varying between $\frac{47}{41} - \frac{49}{42}$ (only two specimens examined). Pterostigma jet-black. Membranula pure white, with its distal portion fading to dark gray along outer margin. Length: abd. 50-56, hw, 49-50 : 13.5-14, pt. $\frac{\geq 3}{3}$ mm..........

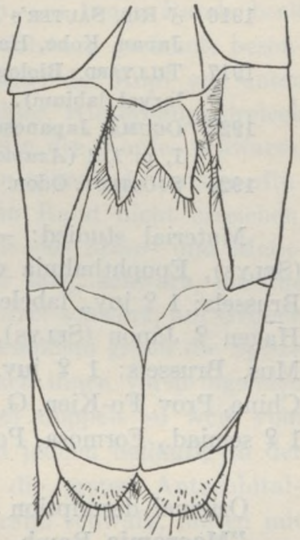

Fig. 16. *E. vittata sundana* LIEFTINCK, ♀ Java (Mus. Leiden). Terminal segments of abdomen, ventral view.

vittata sundana ssp.n.

Epophthalmia elegans BRAUER 1865 (textfigs. 2,12).

1865 ♂♀ **Brauer,** Vierter Ber.Novara Neur., Abh.zool.bot.Ges.Wien, 14, p. 905 (*Macromia*), — Hab.: China, Shanghai.

1866 ♂♀ **Brauer,** Novara-Exp. Zool. I Neuropt., pp. 76-78, Tab. II fig. 4, 4a-c (*Macromia*). — Hab.: idem (same specimens).

1867 HAGEN, Not.b.Stud.BRAUER's Novara-Neur., Verh.zool.bot.Ges.Wien, 17, p. 60. — Hab.: China (remarks).

1868 BRAUER, Verzeichniss Neuropt., II, Idem, 18, p. 742 (*Macromia*). — Same specimen.

1871 ♂♀ **Selys,** Synopsis Cordulines, pp. 91-93 sep. — Hab.: Japan and China.

1883 SELYS, Odon. Japon, Ann.Soc.ent.Belg., 27, p. 110. — Hab.: Japan; Shanghai.

1890 CABOT, Immature State Odon., Mem.Mus.Comp.Zool., 17, 1, pp. 9-11, Pl. 1, fig. 1, 1a-d (*Epophthalmia sp.?*). — Hab.: China, Canton (larva).

1904 NEEDHAM, New Dragon-fly Nymphs U.S.Nat.Mus., Proc.U.S.Nat.Mus., 27, p. 698 (*Azuma* gen.nov.). — Hab.: Japan (larva).

1904 BUTLER, The Labium of the Odonata, Trans.Amer.Ent.Soc., 30, p. 125, Pl. VI fig. 5b-c (*Azuma*). — Hab. ign. (larval labium).

1906 ♂♀ MARTIN, Cat.Coll.SELYS, Cordulines, pp. 63-64. — Hab.: Tonkin, China. Japan (Tonkinese record not mentioned in Mission Pavie 1904!).

1909 WILLIAMSON, North Amer. Drag. Macromia, Proc.U.S.Nat.Mus., 37, p. 370, fig. 1 (*Azuma*; wing-photograph). — Hab.: Japan, Myiazaki.
1914 MARTIN, Gen.Ins., 155, Odon.Lib.Cordulinae, p. 25, pl. I fig. 9 (wings), pl. 2 fig. 16 (insect) (*Azuma*). — Hab.: Australie (errore!), Japan, China, Tonkin.
1916 ♂ RIS, SAUTER's Formosa Ausb., Suppl. Entom., 5, p. 71 (*Azuma*). — Hab.: Japan, Kobe, Harima.
1917 TILLYARD, Biology of Dragonflies, Cambr., pp. 83-85, fig. 32 M (*Azuma*; larval labium).
1922 OGUMA, Japanese Dragonfly-fauna Libellulidae, Deutsch.ent.Zeitschr., Heft I, p. 112 (*Azuma*). — Hab.: Japan, Honshiu, Kiushiu.
1925 SJÖSTEDT, Odon. China, Arkiv f. Zool., 17, p. 2 sep. — Hab.: China, Kiangsu.

Material studied: — 1 ♂ ad., labeled: Japon (SELYS), M. elegans Br. (SELYS), Epophthalmia elegans Br., Rév. R. Martin 1906 (MARTIN) in Mus. Brussels; 1 ♀ juv., labeled: par Mus. Civ. 1891 (SELYS), Epophthalmia elegans Hagen ♀ Japon (SELYS), E. elegans Br., Rév. R. Martin 1906 (MARTIN) in Mus. Brussels; 1 ♀ juv., Shanghai 1907, leg. W. SCHWINGHAMMER; 1 ♀ ad., China, Prov. Fo-Kien, G. SIEMSSEN leg., vend. 1.X.1912; both in Mus. Hamburg; 1 ♀ semiad., Formosa, Polisha, VII. 1908, leg. H. SAUTER, in Mus. Leiden.

Original description (1865):—

"**Macromia** Ramb. **elegans:** nigra, flavo-maculata; fronte aenea, bituberculata, lateribus flavis, clypeo flavo, infra fascia transversa nigra; labro palpisque flavis, late nigro marginatis; occipite nigro, vertice viridi-aeneo; bifido. Thorace viridi-aeneo, striis duabus humeralibus fasciisque lateralibus obliquis flavis; abdomine nigro, flavo fasciato et maculato; alis fusco-hyalinis, apice obscurioribus, pterostigmate parvo, nigro; venis nigris, costa flavo-lineata; area discoidali biseriatim reticulata. Appendicibus analibus superioribus maris nigris, parum curvatis, basi latis, apice subito angustatis, margine externo angulato, interno integro, vix tuberculato, concavo. Appendice inferiori superioribus aequali, triangulari, apice bifida. Appendicibus analibus feminae rectis, brevissimis, segmento ultimo maris supra tuberculato. Nervis antecubitalibus 15—16, postcubital. 8—9.

Long.corp.	♂ 75,	♀ 81 mm.
„ alae sup.	51,	54 „
„ abdom.	52,	58 „
„ pterostigm.	3½,	3⅔„

Patria: China, Shanghai. Von HAGEN als *Epophthalmia elegans* früher versendet, doch meines Wissens nicht beschrieben".

In the Novara-Expedition the latin diagnosis practically remains unaltered and at the same time a very full description of the Shanghai specimens is added in german. For the sake of completeness, and to facilitate a comparison with the closely allied Formosan insect, the above mentioned description may entirely be reproduced:—

"Schwarz, gelb gefleckt, Thorax und Kopf an den dunklen Stellen metallisch grünglänzend; Scheitel grünglänzend, zweispitzig, Stirne oben längs der Mitte gefurcht, zweihöckerig, metallisch grün, an der Seite gelb; Clypeus [postclypeus!] gelb, längs des Ansatzes der Oberlippe eine breite, schwarze Querbinde [anteclypeus!]; Oberlippe am Grunde gelb, am freien Rande breit schwarz eingefasst, Unterlippe gelb, die Seitenlappen schwarz gesäumt, besonders breit an ihrer Berührungslinie längs der Mitte, daher der Kopf von unten gesehen schwarz, mit drei gelben Flecken erscheint. Fühler, Hinterhauptsdreieck und der ganze Hinterkopf glänzend schwarz. Vorderseite des Kopfes schwarz-, Hinterseite fein weiss behaart. Thorax metallisch-grün glänzend, Zwischenflügelraum, zwei breite Schulterlinien, welche den oberen Rand nicht erreichen, dann eine breite, schiefe Seitenstrieme am Hinterrande des Meso- und Metathorax und die Unterseite dieser blassgelb. Beine sehr lang, schwarz, nur die Trochanteren des vorderen Paares unten gelb. Flügelwurzel schwarz, am Grunde der Costa ein gelber Fleck. Flügel bräunlich hyalin, besonders gegen die Spitze gebräunt und beim Manne auch am stark winkelig nach innen vorspringenden Basalende des Hinterrandes. Nodulus im Vorderflügel doppelt so weit vom Grunde als vom Pterostigma entfernt, im Hinterflügel jedoch beiläufig in der halben Flügellänge gelegen. — Flügeladern schwarz, die ersten Antecubitalqueradern am Grunde gelb gestreift, Costa am Vorderrand schwarz, hinten mit gelber Linie. Im Discoidalfelde im Vorderflügel zwei Zellreihen vom Dreieck fast bis zum Ende des *Sector trianguli sup.* Dreieck derselben fast rechtwinkelig, schmal, mit einer Querader. 15—16 Antecubital-, 8—9 Postcubitalqueradern. Pterostigma klein, kurz, schwarz. *Membranula accessoria* grauweiss, nach hinten zu dunkler. Hinterleib beim Männchen am Grunde nach unten verdickt, compress, dann fast cylindrisch bis zum sechsten Ring, vom Hinterrand dieses bis zum Ende depress, spindelförmig erweitert, beim Weibe mehr compress, die hinteren Ringe nicht so stark verbreitert, schwarz, oben der zweite Ring mit gelber Querbinde zwischen den gleichgefärbten Öhrchen des Männchen, beim Weibchen an derselben Stelle die Binde breiter. Dritter bis sechster Ring am Vorderrand mit sehr feiner gelber Querlinie und dahinter mit zwei grossen (jederseits einen) viereckigen gelben Flecken, die nach rückwärts zu kleiner werden; siebenter Ring mit einem die ganze vorderen Hälfte einnehmenden gelben Fleck, der am Hinterrande jederseits dreilappig und in der Mitte am längsten ist, bis über diese hinausreichend; achter Ring am Grunde mit schmalem gelben Querfleck; neunter Ring ganz schwarz; zehnter beim Männchen am Grunde schwarzbraun, in der hinteren Hälfte in der Mitte gelb, von seinem Grunde erhebt sich ein kegelförmiger Höcker, dessen Spitze in zwei stumpfe Körnchen gespalten ist; — beim Weibe ist der zehnte Ring ohne Höcker und ganz schwarz. Anhänge des Männchens schwarz, die oberen so lang wie der untere, leicht einwärts gekrümmt, bis zum äusseren Drittel sehr breit, dann am Aussenrande daselbst, nach einer stumpfen vorspringenden Ecke, plötzlich nur halb so breit, das schmale Endstück am Ende stumpf und etwas verdickt, glatt und durch eine Furche in zwei Felder getheilt. Die übrige Fläche

ist in der äusseren Hälfte körnig rauh und am zweiten Abschnitt des Aussenrandes, d.i. vom zahnartigen Höcker bis zum Ende körnig gezähnt. Der Innenrand ist glatt und concav, gegenüber dem äusseren Höcker fast unmerklich verdickt und borstig schwarz behaart, am Grunde erweitert er sich zu einem winkligen Höcker, der leicht entgeht, weil er sich dem Rande des letzten Ringes anschliesst. Der untere Anhang ist dreieckig, am Seitenrande etwas bauchig, an der Spitze seicht gespalten, stumpf, zweihöckerig, längs der Mitte oben vertieft und braun. Die Anhänge des Weibchens sind sehr kurz und fein, gerade, am Ende feinspitzig, sie überragen kaum das Ende des Leibes und die untere Blase und sind kürzer als der letzte Ring. Die Scheidenklappe ist kurz, breit, am Hinterrand gerade und in der Mitte tief spitzwinklig eingeschnitten; braungelb, am Rande schwarz. Die Unterseite des Hinterleibes ist schwarz, an den letzten Ringen besonders beim Weibchen braun, sonst zeigen der 2., 3. und 6. — 10. Ring am Grunde zwei gelbe Flecken; beim Weibchen ist auch der sechste Ring unten noch einfärbig. Ausser den schon erwähnten Punkten zeigt das Weibchen breitere, gelbe Flecke am Hinterleib und die Trochanteren der Vorderbeine sind oben sehr schmal geschwärzt. Der Mesothorax ist bei beiden Geschlechtern vorne dicht und fein weiss behaart, eben so die Basis des Hinterleibes. — Körperlänge ♂ 75, ♀ 81 Millim.; Länge des Hinterleibes ♂ 52, ♀ 58, der Anhänge ♂ 3, ♀ 1⅓, des Vorderflügels ♂ 51, ♀ 54, des Pterostigma ♂ 3½, ♀ 3⅔ und Länge des Hinterschenkels ♂ 13, ♀ 14 Millim. Vaterland: China (Shanghai)."

To this excellent description no additions are required. A drawing (not coloured) of the entire male insect and two outline-figures of its anal appendages on Tab. II are pretty well succeeded, though obviously some slight inaccuracies have crept in when looking on some of the wing-veins. These figures were drawn by H. SOMMER.

According to HAGEN (loc. cit., p. 60) the appendix inferior of the male may be as long as the superiors or even slightly shorter. In the specimen from Japan it overlaps the tips of the superior ones for a trifle, as already observed by DE SELYS who described this male in the Synopsis.

To Mr. MORTON I owe a drawing of the anal appendages of a male from China not differing from that of a second one reproduced in the present paper. The same author has kindly pointed out his views with respect to the variability of this species which, so far as colours are concerned, cannot easily be separated from its nearest ally described hereafter. In order not needlessly to repeat myself I have discussed MORTON's correspondence on the subject under the next species, since most of his remarks refer to that insect.

When comparing other species of the genus, the number of nodal cross-veins in *elegans* is comparatively low: — ♂ antenod. $\frac{14\text{-}16}{11}$, postnod. $\frac{8\text{-}9}{9\text{-}11}$; ♀ $\frac{13\text{-}14}{10\text{-}10}$, $\frac{8}{9\text{-}10}$ (Shanghai), $\frac{16}{11}$, $\frac{8\text{-}9}{11}$ (Japan), $\frac{14}{10}$, $\frac{9}{10}$ (Formosa), the total

number of cross-veins added up in both front and hind wings being variable between $\frac{43}{39} - \frac{49}{44}$.

It varies greatly in size: Brauer gives ♂ abd. + app. 55, fw. 51; ♀ 58 + 1⅓, 54 (China), and Selys ♂ abd. (excl. apps.) 52 - 58, hw. 54; ♀ 56 - 58, 58 mm. — The measurements of all specimens under examination are: ♂ abd. + app. 55-61, hw. 54-55 : 16, pt. $\frac{3.5\text{-}3.8}{3.5\text{-}3.6}$; ♀ 56 - 62, 52½ - 58, $\frac{3.5\text{-}<4}{3.5\text{-}3.8}$ mm. The male in the Brussels Museum is apparently the largest specimen recorded; its measurements are: 61, 55: 16, $\frac{3.8}{3.6}$ mm.

The females do not markedly differ from each other; all examples agree in having the tips of all wings yellowish enfumed and their wing-bases, especially the basal portion of the hinder pair, comparatively narrow.

It is impossible to confuse this splendid species with any of its allies, except perhaps with the doubtful specimen described below, the male of which may be distinguished by characters given in the tabular description. The coloured picture of the male in Wytsman's Genera Insectorum is perfectly characteristic, as most of the drawings in that work.

D i s t r i b u t i o n. — A species inhabiting eastern continental Asia including Japan and reaching at least as far southwards as Formosa. Perhaps Tonkin should also be added as a habitat, although this country was only once given by Martin who omitted the record some years afterwards. The few exact localities available to me in literature are Shanghai and Canton, and the provinces Fo Kien and Kiangsu in China; Kobe, Harima, Honshiu and Kiushiu in Japan. The Formosan female in the Leiden Museum is the only doubtless specimen known from that country.

Concerning habits and flight no data are available in literature.

The larva has been described and figured *postea*.

Epophthalmia elegans, subsp.? (textfig. 3 and pl. 1 fig. 1).

Material studied: — 1 ♂ ad., Formosa, without date, in coll. K. J. Morton.

The description of the unique specimen (partly assimilated into the tabular key on page 32 of this paper) may be amplified as follows:—

Insect of huge size with bright metallic green and black coloration, brightest yellow markings on thorax and very sharply limited, rather peculiarly restricted spots on abdomen.

Dorsal surface of frons and vertex brilliant metallic green, slightly intermingled with blue. Eyes chestnut-brown. Ground-colour of synthorax uniform metallic green, very shining; spaces between the wings black, spotted with yellow. All light markings sharply limited, clear yellow. Legs jet-black excepted coxae and trochanters which are spotted with yellow.

Wings hyaline; a faint yellowish shade in the postero-basal corner of hinder pair. Neuration black except interior side of costa which is narrowly lined with yellow from base up to the nodus. Pterostigma black, covering about two underlying cells. All triangles crossed. Supratriangles with two or three cross-veins in front wing, one in hind wing. Subtriangles in front wing with their proximal (interior) side irregularly broken. Anal loop shaped as in typical *elegans* but only containing seven cells, the central one wanting. Nodal index: $\frac{9.14.}{10.12.}\Big|\frac{14.10.}{11.10.}\ (\frac{47}{43})$.

Abdomen comparatively slender, wholly deep black with bright conspicuous, very sharply cut yellow markings as described *antea*. Venter black. Anal appendages see fig. 3.

Length: abd. + app. 59, hw. 52: 15, pt. $\frac{4}{4}$ mm.

Mr. Morton kindly gave me his opinion on this example, at the same time adding some of his observations on the variability of true *elegans*; he remarks:— "The fine example from Formosa is perhaps very near the big Japanese species, yet is seems a less heavy insect and also I think there is a slight but distinct difference in the shape of the superior appendages" (in litt., 18th Jan. 1928) and: — "With regard to the *Azuma* from Formosa, I confess that apart from the slightly less bulky appearance and the noticeable, although not great, difference in the shape of the sup. apps., I could see little else to distinguish it from *elegans* ...... The yellow abdominal markings in the ♀ of *elegans* are much larger than in the ♂ and the markings are present even on the 6th segment, and they are hardly interrupted on the dorsal carina except perhaps on the 3rd, although on some of the other segments the carina is a little darker, giving just a hint of being interrupted. In the ♂, the markings excepting the large one on 7th, are less extensive and the interruption at the dorsal carina on the anterior segments more decided; as Selys says in the Synopsis, those on 6th are smaller, in fact I was not perfectly sure of their presense until I had washed the segment with toluol which revived the spots in one ♂ but in the other one which I have, the spots on this segment have either disappeared beyond recovery or have never been present. On the posterior part of segment 10 of the ♂, there is a very large pale dorsal spot which Selys does not appear to mention .... but I have made the enclosed rough camera-lucida drawing of the apps. of *elegans* which I think gives a fair idea of their appearance." (in litt., 28th Jan. 1928).

The identification of this much discussed insect has given me a lot of trouble. As already hinted at on several occasions it is most closely allied to the former species with which it agrees in almost every respect. Added to this, the country whence the example came is also occupied by *elegans* but no males of this latter species have hitherto been recorded from Formosa so that it remains an open question whether the Formosan representative is

a very similar, though perhaps distinct, species or only a geographical race of the true *elegans* from Japan and China. The occurrence of two related species in the same country is not astonishing; on the other hand the modern conception of zoogeographical problems does not exclude the possibility of racial intermingling demonstrated by a single species in the same region. However it may be, it seems wise for the present not to give it specific or subspecific rank but to await further material from Formosa before connecting the two forms in whatever way. It may be recognized in future with the aid of the coloured picture appended to this paper and drawn by one of our native artists as carefully as possible.

Epophthalmia frontalis SELYS 1871 (textfig. 4 and pl. 1 fig. 2).

1871 ♂ Selys, Synopsis Cordulines, pp. 93-94, 95 sep. — Hab.: „Malaisie?"
1906 ♂ MARTIN, Cat.Coll. SELYS, Cordulines, p. 62, *nec* fig. 79 (apps.); Pl. II fig. 12 (insect). — Short description of type specimen.
1914 MARTIN, Gen.Ins., 155, Odon.Lib. Cordulinae, p. 26. — Hab.: Malaisie, teste SELYSI.
1921 FRASER, Indian Drag., X, J. Bombay N. H. Soc., 27, p. 681. — Description, teste SELYSI.

Material studied: — 1 ♂ ad., labeled: Deyrolle, Malaisie? (SELYS, white label), Epophthalmia frontalis Selys ♂ (SELYS, white label), 59 (in lead-pencil, indicating it having been drawn for the monograph), Epophthalmia frontalis Sel., Rév. Martin 1906 (MARTIN), Epophthalmia frontalis Selys (MARTIN, Type, in red print).

Original description:—
"59. **Epophthalmia frontalis,** DE SELYS.
♂ Abdomen 53. Aile inférieure 48.
♂ Ailes hyalines, un peu salies au bout; un léger vestige brun à l'extrême base des inférieures et un nuage brun clair enfumé à l'angle anal; membranule gris clair; ptérostigma brun foncé couvrant 1½ cellule (long de 3½ mm); 14 antécubitales, 6—7 postcubitales, 3 hypertrigonales, 5—6 médianes; 2—3 cellules puis 2 rangs postrigonaux aux supérieures. Réticulation noirâtre, costale finement jaune en dehors.

D'un brun noirâtre varié de jaune. Lèvres et face roussâtre avec deux petites taches basales transverses à la lèvre supérieure, une raie basale complète au nasus et quatres taches basales ovales formant une série transverse au front, savoir: une à chaque côté de l'échancrure et une latérale entre celle-ci et les yeux se dessinant sur le front, qui est noirâtre acier. Thorax brun noirâtre un peu châtoyant, ayant en avant les sinus antéalaires, une raie antéhumérale un peu courbée ne les touchant pas, et sur les côtés une raie oblique jaune faisant le tour du thorax entre les ailes. Abdomen cylindrique, renflé à la base, et un peu épaissi aux 6—10e segments, noirâtre annelé de

jaune foncé savoir: un anneau submédian complet aux 2 et 3e, occupant presque la moitié basale aux 4—7e; plus étroit et basal aux 8 et 9e; et le dessus du 10e jaunâtre pâle. Les côtés et le dessous des trois derniers segments brun clair. Pieds brun noirâtre.

10e segment un peu bossu à sa base en dessus. Appendices anals brun foncé, les supérieurs un peu plus longs que le 10e segment, épais, un peu courbés en crochets. Leur première moitié se termine en dehors par un coude anguleux; leur bout est mousse. Appendice inférieur un peu plus long, triangulaire à peine recourbé en haut, l'extrémité un peu tronquée.

♀ Inconnue.

Patrie: Malaisie? (Coll. Selys).

N.B. Voir la comparaison avec les espèces voisines à l'article de la *vittata*."

After giving the following diagnosis of *E. australis*: — "L'*australis* se sépare par la costale noire, la membranule noirâtre, la tête sans marques jaunes, le devant du thorax avec une raie jaune, très-courte inférieure, les anneaux jaunes de l'abdomen très-étroits", the above cited 'comparaison avec les espèces voisines' runs as follows:—

"La *frontalis* en est l'opposé: les quatre taches assez grandes du front et les deux de la base de la lèvre supérieure, puis la bande du nasus, enfin les anneaux jaunes de l'abdomen très-larges." (l.c. p. 95 sep.).

One of the most carefully described and yet the most mysterious species of the genus.

The type-specimen was intentionally redescribed and arranged in the key because it is certainly *bona species*. In the Brussels Museum I was able to convince myself at once of the inaccurately drawn figure of the anal appendages reproduced in MARTIN's monograph. When comparing this figure 79 with the camera lucida drawing in this paper, it is evident that MENGER's figure is incorrect and possibly was taken from an other species, although I do not know to which it might belong. Seen from above the superior ones are much straighter and in side view the distal portion carries a number of small denticles. Besides, the tenth abdominal segment of the type male of *frontalis* bears a distinct slightly notched cone at its base, whereas on the figure in the monograph the same segment appears completely flattened.

The coloured drawing of the entire insect on Pl. II in the same work (fig. 12) is passable, though not very characteristic: the head is much too large, the wings are too short and the alternating colours of the abdomen all too diagrammatic. In reality this species is very similar to *E. vittata vittata* in general aspect, though more compactly built, and the yellow spots on the dorsal portion of the frons as well as the different shape of the superior anal appendages will serve to its recognition.

One of the most striking features of this insect to which no special attention has been paid (but possibly being only of individual value!) is the considerable widening of the basal portion of the hind wing, which feature is not nearly so striking in any of the other species. The anal triangle of right hind wing is incidentally traversed by two cross-veins.

Nothing is known about its habitat and all records or identifications following the original description must be considered as problematic or false, except, perhaps, the specimen mentioned below.

From FRASER's notes on the species (loc. cit. 1921) the following lines may be quoted:—

"The abdominal rings are not a very variable guide as they vary greatly in breadth in *vittata* and are broad in *vittigera*. The spots on the front are the only specific differences and it is more than probable that *frontalis* is merely a local variety of the two species mentioned. The anal appendages of the three species do not present any marked differentiation."

It is obvious that the author's remarks are incorrect. The markings on the abdomen in *vittata* and *vittigera* are largely different and not at all broad in the last mentioned species. Moreover there is a well-marked difference in the shape of the anal appendages between *vittata* and *vittigera* and lastly FRASER's statement that *frontalis* is merely a local race of the two (sic) species is not based on a comparison, as *frontalis* and *vittigera* were unknown to him.

Epophthalmia species (cf. frontalis SEL.) (textfig. 5).

Material studied: — 1 ♂ semiad. (rather defective and deformed by pressure), labeled: Khasia Hills, Assam (unknown hand), Kasia Hills Heine (SELYS, yellow label) in Museum Brussels.

Closely allied to *frontalis* and perhaps a distinct species.

A single immature specimen of rather problematic position but evidently very near *frontalis* and not especially related to the *vittata* Formenkreis. Apart from its smaller size and less heavy appearance it differs markedly from *frontalis* in the shape and the venation of its wings, the superior anal appendages being also different (fig. 5). Unfortunately of both species only a single male example is present, so that nothing definite can be said about the extent of individual variation as regards wing-venation or shape of the anal appendages. When comparing other species of the genus of which more material is available (*vittigera, australis*), in a series of males of each of these species the structure of the above mentioned organs does not seem to be very variable, so that I am rather inclined to think the Assam male representing a distinct species. The specimen lacks an identification-label, and even MARTIN seems to have overlooked it when studying the *Epophthalmia*'s in the old DE SELYS collection. To the diagnosis given in the tabular description (pp. 34-35) no additions are required.

A second — very doubtful — specimen, possibly belonging to a species allied to *frontalis* but not inserted in the descriptive account, bears the following labels: — Tocklay [N. India], 8.XI.1919, "head cut off in net" (unknown handwriting), and: Epophthalmia frontalis ♂ (in FRASER's hand). This example is in excellent condition, wholly adult and may be a true *frontalis*. The caudal appendages are somewhat different in shape but there is a distinct lateral tooth. As, however, its head is simply wanting, I am again not capable of identifying it, although FRASER referred it to *frontalis*. The specimen may be briefly characterized as follows:—

Synthorax dark metallic green with clear yellow bands slightly narrower than in *vittata* and much narrower than in typical *frontalis*, especially so the lateral yellow fascia. Wings hyaline, shaped as in *vittata*. Pterostigma of equal form, nodal index $\frac{8.15.}{11.12.}\Big|\frac{15.8}{13.9}$ $(\frac{46}{45})$. Anal loop normal, 9-10 celled, with central cell. Hind wings, as in most species of the genus, with anal angle cloudy yellow. Ground-colour of abdomen from base to end of segm. 6 deep black with yellow rings well-defined behind, slightly smaller than in *vittata* and even more so when comparing *frontalis*. The ring on dorsum of segm. 2 comparatively narrow, entire. Remaining segments (7—10) from dark reddish brown gradually passing to light brown including the appendages. Basal yellow rings on 7—8 conspicuous, on 7 occupying about ¼ of the length, that on 8 narrower, broadest on mid-dorsum. Segm. 9—10 unicolorous. Shape of abdomen as in *vittata vittata*.

Superior anal appendages distinctly concave when seen in profile, with a well-developed extero-lateral tooth at the middle (versus *vittata* and its races!) Inferior appendage about 1 mm longer than upper pair.

Length: abd. + app. 52, hw. 48 mm.

In spite of its lamentable decapitation I venture to say that, in my opinion, this male has no affinities to the *vittata*-group of the genus, being perhaps identical with the species from Assam, described and figured above. I can not find any difference of much importance in the anal appendages between these two insects (fig. 5).

Epophthalmia vittata vittata BURMEISTER 1839 (textfig. 7, 15).

1839 ♂ BURMEISTER, Handb. der Entom., II, p. 845 (*vittata*). — Hab.: Madras.

1867 ♂ Hagen, Not.b.Stud.BRAUER's Novara-Neur., Verh.zool.bot.Ges.Wien, 17, pp. 59-60 (*vittata*). — Type specimen described.

1868 ♂ BRAUER, Verzeichniss Neuropt., II, Idem, 18, p. 742 (*Macromia*). — Record of same specimen.

1871 ♂♀ Selys, Synopsis Cordulines, pp. 94-95, 96 sep. (*vittata*). — Hab.: Andaman Is., Thibet, Bengal, Madras.

1898 ♂ CALVERT, BURMEISTER's Types Odon., Trans.Amer.Ent.Soc., 25, pp. 56-57 (*vittata*). — Type examined.

1906 MARTIN, Cat.Coll.SELYS, Cordulines, p. 62 (*vittata*). — Hab.: India, Andaman Is., Thibet.

?1909 Williamson, North Amer.Drag.Macromia, Proc. U.S.Nat.Mus., 37, p. 371, fig. 2 (*Epophthalmia, species*? Burma, wing-photograph).
1914 Martin, Gen.Ins., 155, Odon.Lib.Cordulinae, p. 26. (*vittata*). — Vide sub 1906.
1919 Fraser, Descr. new Indian Odon. larvae a. exuviae, Rec.Ind.Mus., 16, pp. 459-460, pl. 32 fig. 1 (insect); pl. 34 fig. 2 (labium) (*frontalis*). — Hab.: India, Poona (larva).
1921 Fraser, Indian Drag., X, J.Bombay N.H.Soc., 27, pp. 679-680 (pars!), fig. 2 (drawing of wings) (*vittata*). — Hab.: W.Pen.India, Poona.
1923 Laidlaw, Drag.Fauna Malay Peninsula, I, J.Mal.Br.Roy.Asiatic Soc., I, pp. 332-333, fig. 1 (*Azuma*). — Drawing of larval wing-pads (Calcutta specimen).
1924 Fraser, Report Odon.Andaman Is., Rec.Ind.Mus., 26, p. 409 (*Azuma*). — Hab.: Andaman Is. (teste Selysi).
1924 Fraser, Survey Odon. W.India, Ibidem, pp. 446-447 (*Azuma cyanocephala*). — Hab.: Penins.India: Nilgiris, Malabar.

Material studied: — 1 ♂ ad., labeled: Ind. or (in ink), Stev. (Selys), Epophthalmia vittata, Burm. ♂ (Selys), Epophthalmia vittata Burm., Rév. Martin 1906 (Martin); 1 ♂ semiad., labeled: Thibet, Dup. (Selys, orange label), Epophthalmia vittata Burm., Rév. Martin 1906 (Martin); 1 ♀ ad., labeled: Bengale (Selys, pink label), M. vittata ? Burm. à renvoyer ♀ ♂ (Selys, yellow label), Epophthalmia vittata Burm. ♀ (Selys, white label), Epophthalmia vittata Burm., Rév. Martin 1906 (Martin); 1 ♀ ad., labeled: Macromia vittata ? Burm. ♂ (Selys, yellow label), Vittata B. (Selys, orange label), Epophthalmia vittata Burm., Rév. Martin 1906 (Martin). — All specimens in Mus. Brussels. — 1 ♂ ad., S. Penins. India, Malabar, Palghat, 16.VI.1921, leg. T. N. Hearsey (ex coll. Fraser), in coll. m., with the following remarks on the paper: — "♂ No. 1. Eyes a peacock blue-green. Markings on thorax bright yellow and greenish black, on abdomen bright ochreous with dark brown bands. 7 to 10 segment brown. Palghat 16.6.21, in cop. with No. 2." (T.N.H.). — 1 ♂ ad., labeled: Azuma cyanocephala ♂, Poona [W. Penins. India], 1918 (Fraser), in coll. F. F. Laidlaw.

Original description:—

"1. E. v i t t a t a*: fusca, fronte supra ocellorumque tuberculo chalybaeo; thoracis vittis sex, striga mesonoti ante alas, metanoto, abdominisque cingulis flavis.

♂. cercis operculo anali flavo brevioribus, obtusis, aduncis flavis; alae posticae in basi nubecula fulva. Long. 3″.

♀. non vidi.

Von Madras; aus der Sendung des Herrn K i n g an den vormaligen Missionär Herrn S c h m i d t erhielt das Hallenser Museum diese höchst ausgezeichnete Art. Flügelzellen sehr gross, das braune Randmahl ist lang, aber doch kürzer als 2 Zellen. In jedem Flügeldreieck eine Querader; in dem Raum hinter dem Dreieck der Vorderflügel anfangs 2 Zellenreihen, obwohl das Dreieck sehr hoch ist.".

From this very short diagnosis only a fair idea of the appearance of BURMEISTER's insect could be obtained, the author's remark *'thoracis vittis sex ...'* also giving rise to some divergence of opinion, but afterwards all doubt was abolished by HAGEN who re-examined the type, giving a very careful description of it:—

"1. *E. vittata* BURM. Ich habe die Type ein Männchen aus Madras genau beschrieben und zwar stets im Vergleich mit *E. elegans.*

Unterlippe und ihre Lappen hellbraun, etwas röthlich, ohne gelben Seitenfleck; Oberlippe röthlich braun mit schmälerer strohgelber Basalbinde; Rhinarium röthlich braun; Epistom strohgelb, mit querer brauner Binde als Verlängerung des Rhinarium-Randes; die beiden Eindrücke braun. Stirn blau, metallglänzend, mit kleineren gelben Seitenflecken, und einem zweilappigen gelben Fleck oben in der Mitte der Aushöhlung. Fühler schwarz, Ende der Borste braun; Scheitelblase gross, metallblau, mitten ausgeschnitten, zweizipflig. Augen hinten schwarz, unten neben dem Munde ein brauner Fleck. Hinterhaupt klein, schwarz, wenig erhaben, hinten polirt, etwas gewölbt. Thorax röthlich braun, mit metallblauem Schein oben und seitlich neben den Binden. Die gelben Binden oben etwas schmäler und gekrümmt, mit stumpfem Ende; die gelbe Binde, die zwischen den vier Flügeln hindurch geht, etwas schmäler; eine zweite Seitenbinde fehlt ganz. Thorax unten hinter den Füssen röthlich braun, Leib etwas länger und schlanker, Basis und Spitze weniger aufgetrieben. Die Färbung scheint wie überhaupt bei dem ganzen Thiere nicht vollendet ausgebildet; erstes Segment braun, oben gelb an der Basis; zweites Segment mit schrägerer Binde, welche oben die Basalhälfte freilässt; in der Mitte der Basis ein kleines gelbes Dreieck; viertes bis sechstes Segment braun, die Basalhälfte gelb, doch sind beide Farben nicht scharf getrennt; die folgenden Segmente schmutzig ledergelb, mit dunkleren Seitenflecken. Das letzte Segment ist nicht gegen die Spitze verengt, auch nicht abhängig, sondern eben, mit zwei sehr genäherten kleinen Basalhöckern; Spitzenrand kürzer, Appendices gelb; die oberen etwas länger als das letzte Segment, blattartig, wenig gekrümmt, Spitzendrittel verjüngt, aussen schräge abgeschnitten, der Zahn wenig markirt. Unterer Appendix etwas länger, nach oben gekrümmt, schmäler, verjüngt gegen die mit zwei Hökerchen versehene Spitze. Oehrchen an der Seite des zweiten Segments klein gelb, nach hinten gespitzt; Bauchrand desselben Segments gut entwickelt, an der Spitze gestutzt, nach innen verdickt; Lamina anterior gerade, der Rand etwas dicker aufgebogen, und gegen die Spitze verengt; Hamulus breit blattartig, die Spitze stark verjüngt, kürzer fast gerade. Füsse schwarz, die Hüften und die Vorderschenkel unten röthlich braun. Flügel spitzer; 15 bis 16 Antecubitales, sonst wie bei *E. elegans;* Membranula weiss, längs dem Rande des Flügels braun; Pterostigma etwas kürzer besonders an den Hinterflügeln, deren Basis etwas angeraucht ist.

Länge 78 mill.; Leib 57 mill.; Flügel 52 mill.; Appendices 3 mill.; Pterostigma 3 mill.; Flügelspannung 104 mill.; Kopf 10 mill."

From this excellent and very careful description it appears evident that SELYS was right in referring the specimens in his own collection to BURMEISTER's species. HAGEN's description is typical for apparently almost fully mature examples in which, however, the metallic shine on the frons and on synthorax has not yet attained its highest intensity, thus giving the insect a "general colouring of ochreous brown, marked with yellow", as FRASER says (loc. cit. 1921). The male specimen from Poona, W. India, agrees so perfectly with the description of the type from Bombay as given by HAGEN that I could almost follow this step by step, although the Poona insect still seems to be slightly younger than HAGEN's. Older examples from the same locality were characterized by FRASER as follows: — "In the male, the upper part of the front of thorax and the brown part of the sides less so, are a fine, metallic green. The costa is finely yellow on the superior surface only, and as far out as the stigma, which is deep brown, almost black. The upper part of frons and the vesicle are metallic green, with a bright yellow spot just in front of the vesicle. The neuration of the wings is similar to *E. vittigera,* Ramb., from Java and Borneo and doubtfully, Assam. The yellow annules on the abdomen differ somewhat, as follows: — that on the 3rd occupies its middle third, on the 4th, 5th and 6th nearly as much as the basal half but the apical border of the rings is much clearer cut than the basal, which is diffuse, the annule on the 7th occupies the basal third and on the 8th and 9th, obscurely, the greater part of dorsum.

Female similar but the facial markings more obscure and the rings on the abdomen much broader, of which the ground colour is pale ochreous brown. In old specimens the greater part of the wings is suffused with a dirty yellow, rather patchy in its distribution." (l.c. 1921, p. 680).

Besides, the following remark on the coloration of the female wing was given: — "At the base of the hindwing, between the costa and the submedian nervure, a brownish ray, extending as far out as the 1st antenodal nervure. The outer fifth of the wings is usually clouded with a dirty yellow or pale brown."

With these notes my specimens are in full harmony.

I have made up a composition of characters demonstrated in both young and fully matured examples; the reader will find this in the tabular description (pp. 36-37).

Originally the interpretation of the different species at the end of SELYS's description of *vittata* made it appear to me as if *vittigera* were almost identical with our species: — "La *vittata* en est excessivement voisine, mais paraît distincte de la *vittigera* par les appendices anals jaunâtres, les ailes peu ou point brunes à la base, la lèvre supérieure avec deux taches, une tache basale unique au front (et une à chacun des côtés de celui-ci)." — This observation, however, was easily understood and not astonishing at all when carefully reading over SELYS's description of *vittigera* in behalf of which some Javan examples of *vittata sundana* were also employed! This became clearly evident at

the time of looking over the material in the Brussels Museum (cf. the enumeration of specimens under *vittata sundana*).

As regards neural characters the following data, borrowed from the available material, are perhaps not superfluous:—

Nodal indices ♂: Palghat $\frac{7.15.}{10.11.}\Big|\frac{15.9}{11.10}\left(\frac{46}{42}\right)$, Ind. or. $\frac{7.17.}{9.12.}\Big|\frac{16.6}{12.9}\left(\frac{46}{42}\right)$, Poona $\frac{7.17.}{11.12.}\Big|\frac{16.7}{11.10}\left(\frac{47}{44}\right)$, Thibet $\frac{-.16.}{9.11.}\Big|\frac{15.-}{12.10}\left(\frac{\text{def.}}{42}\right)$. Nodal indices ♀: hab. ign. $\frac{7.14.}{8.11.}\Big|\frac{15.7}{11.8}\left(\frac{43}{38}\right)$, Bengal $\frac{7.15.}{8.11.}\Big|\frac{15.6}{12.9}\left(\frac{43}{40}\right)$. Old specimens of rather buff coloration with dark brown to almost black pterostigma.

L i f e H i s t o r y. — Not very much is known about the life-history of this species. A single adult larva was studied by Dr. LAIDLAW, and two others were briefly described and figured by Dr. FRASER, from examples taken near Poona (vide postea).

The next observations are taken from FRASER's report on *vittata*:—

"Widely but sparingly distributed from Igatpuri to Malabar and probably to the extreme south of Travancore. I found it moderately common at Mahableshwar and Poona during April and May and at the latter place took quite a number sleeping at midday in mango trees in the Empress Gardens. Here exuviae were occasionally found along the banks of the rapidly flowing Mullah canal but in Coorg it breeds in still waters and I have found numbers of exuviae clinging to grasses bordering the small pulp tanks in coffee plantations. Kallar is the only locality in the Nilgiris in which I have observed it and it is unknown from the Palni Hills. Mr. T. N. HEARSEY has sent me a number from Palghat, Malabar, where he states that it is fairly common (In the Bombay Nat. Hist. Journal I quoted *A. vittata* in error for this insect as from Poona)."

A specimen from the Andaman Islands was recorded by SELYS in the Synopsis but it is not present in the collection of the Brussels Museum; an examination of this insect could have been of very high interest. Does it still exists?

Epophthalmia vittata cyanocephala HAGEN (textfig. 6)

1867 ♂ **Hagen**, Not.b.Stud. BRAUER's Novara-Neur., Verh.zool.bot.Ges.Wien, 17, pp. 60-61 (*cyanocephala*). — Hab.: Ceylon.

1868 BRAUER, Verzeichniss Neuropt., II, Idem, 18, p. 742 (*Macromia*). — Hab.: Ceylon, teste HAGENi.

1871 ♂ SELYS, Synopsis Cordulines, pp. 97-98 sep. (*cyanocephala*). — Description, teste HAGENi.

1893 KIRBY, Cat.Neur.Odon.Ceylon, J. Linn.Soc.London, Zool., 24, p. 557 (*cyanocephala*). — Hab.: Ceylon, loc. diff.

1906 ♂ MARTIN, Cat.Coll. SELYS, Cordulines, p. 63, *nec* fig. 80, *nec* Pl. II fig. 13 (insect) (*cyanocephala*). — Hab.: Ceylon, teste auctt.

1914 MARTIN, Gen.Ins., 155, Odon.Lib.Cordulinae, p. 26 (*cyanocephala*). — Idem.

1921 ♂ FRASER, Indian Drag., X, J. Bombay N. H. Soc., 27, pp. 678-679 (*pars!*) — Idem.

1924 ♂♀ **Laidlaw**, Cat.Odon.Ceylon (Coll. GREEN), Spolia Zeylanica, 12, 47-48, pp. 342-343 (*Azuma*). — Hab.: Ceylon, Kandy.

Material studied: — 1 ♂ ad., Ceylon, Kandy, 17.IX.1924, leg. Mr. HENRY, in coll. LAIDLAW.

Original description:—

"Ein Männchen meiner Sammlung aus Ceylon von NIETNER.

Länge 71 mill.; Leib 51 mill.; Flügel 50 mill.; Appendices 3½ mill.; Pterostigma 3½ mill.; Flügelspannung 106 mill.; Kopf 10 mill.

Der Beschreibung nach unterscheidet sich das stark ausgefärbte Männchen von *E. vittata* in folgenden Merkmalen. Lippen und Kopf vorn bis zur Stirn schwarz; an der Basis der Unterlippe jederseits ein gelber querer Fleck; Epistom oben mit gelber schmaler Querbinde, die in der Mitte durch die schwarzen Quereindrücke schräge gespalten wird; im Aussenwinkel des Epistoms und an der Seite der Stirne ein kleiner gelber Fleck. Die gelben Binden auf dem Thorax oben gerade, nicht gekrümmt. Die gelbe Seitenbinde schmäler. Leib kürzer, schwarz; erstes Segment in der Mitte der Basis mit sehr kleinem gelben Dreieck; zweites Segment mit ähnlichem Fleck und schmaler Mittelbinde, die seitlich schräge über die Oehrchen zur Basis läuft; drittes Segment oben mit zwei grösseren, viertes mit zwei kleinen gelben Mittelflecken; Basalviertel des siebenten Segmentes gelb; zehntes Segment gegen die Spitze braunroth; unten ist der Analrand des Segments gegen die Basis hin gelblich. Die Oberfläche des letzten Segments und die schwarzen Appendices stimmen in Form und Verhältniss meiner Zeichnung nach mit *E. elegans*, doch sind die oberen in dem verschmälerten Spitzentheil unten vielfach mit spitzen Höckern besetzt, die ich bei *E. elegans* nicht angemerkt habe. Lamina anterior mit doppelter verdickter Spitze; Hamulus verschieden, sein äusserer Rand an der Spitze in einen kleinen nach oben umgebogenen scharfen Haken verlängert, während bei *E. vittata* nach meiner Zeichnung der untere Rand in einen geraden Zipfel ausläuft. Flügel wie dort; 17 Antecubitales; Füsse ganz schwarz.

Ich habe in meiner Ceylon-Synopsis diese art als *E. vittata* BURM. aufgeführt, und hielt das Stück für ein ausgefärbtes Männchen. Ich meine aber, dass die angeführten Differenzen namentlich der Genitalien, und die Kürze des Leibes die Abtrennung der Art rechtfertigen.

In der Ceylon-Synopsis habe ich Rambodde als Fundort aufgeführt; vielleicht irrig, denn das vorliegende Männchen habe ich von DOHRN erhalten, ehe ich persönlich mit NIETNER in Verbindung stand, und aus jener Zeit stammt ein beträchtlicher Theil der von NIETNER eingesandten Neuroptera aus den tiefer gelegenen Gegenden der Insel, namentlich aus Colombo." [sic].

The reasons why considering the dark Ceylonese *Epophthalmia* as a subspecies of the Indian *vittata* BURM., and not as a distinct species, may be obvious from the characters given in the table before. Structurally *vittata* and *cyanocephala* are very similar to each other, and if there were no constant differences in the colour design of the body the two races could be regarded as belonging to one and the same form. These colour-differences however, are very clearly demonstrated, and HAGEN as well as KIRBY and LAIDLAW agree in their understanding of this phenomenon. Not to mention those colour-changes which are due to age and phase of maturation — differences which in most cases are easily understood — I regard this case of melanism as of sufficient evidence and importance.

In HAGEN's description of the accessory genitalia of *cyanocephala* a wrong impression of the shape of the hamulus is called forth by his statement that this should be structurally different from that of *vittata vittata*. This is certainly not the case, the different shape of the hamulus evidently being due to a distortion or at any rate unnatural situation of the organ between the lobes, the correctness of this view being sufficiently guaranteed after having made a careful comparison of the hamuli in all the species of the genus which I have examined.

BRAUER and SELYS appear not to have seen any specimen of the true *cyanocephala*, and the single supposed example mentioned by RENÉ MARTIN in the monograph does not belong to this subspecies. In reality MARTIN examined a teneral male of *vittata sundana*, the Javanese race of *vittata*, which is labeled "Java, Ploem", and is still in existence. All figures of *cyanocephala* sensu MARTINI-1906 have been drawn from this very immature Javan specimen, the neuration (even the cross-veins!) shown on Pl. II fig. 13, as well as the colour-pattern of the abdomen being exactly identical to those of this insect. I could not find any other specimen in the Brussels Museum agreeing with the figure of the anal appendages and the coloured plate of the entire insect. Here confusion has gone too far! Under the blue drawer-label "*cyanocephala*" the above named male of *vittata sundana* has been placed; it bears the following pin-labels: Java, Ploem (SELYS's hand), Epophthalmia cyanocephala Hag. ♂ (SELYS's hand), 58 (large pencil figures on orange label, apparently from MARTIN, indicating that it was figured for the monograph!) and Epophthalmia cyanocephala Hag., Rév. R. Martin 1906 (MARTIN). The insect is entirely decomposed by pressure and therefore it must have been impossible to make an exact figure as fig. 80 of the anal appendages and a fig. 13 on Pl. II of the entire insect. Hence it is beyond dispute that the artist of these figures has largely indulged himself in fancies.

Next to mention is the "Catalogue of Dragonflies (Odonata) recorded from Ceylon, based on material collected by Mr. E. E. GREEN, with description of a new species", of Dr. LAIDLAW and containing also some interesting remarks concerning our insect. As the female is here briefly mentioned for the first

time, it seems worth while to copy the author's notes entirely, however fragmentary they are:—

"1 ♂ ad., May. 2 ♀♀ teneral. Kandy, September, 1911.

Closely allied to *E. vittata* (Burm.) from the mainland this species is, I think, sufficiently distinct to deserve a specific name. It is one of the largest and handsomest of the Libellulidae.

♂ Abd. 50 + 2.5, N.W. 47.5 mm.

♀ Abd. 53 mm, N.W., 50 mm.

The female specimens are both teneral, their colouring seems to differ, but little from that of the male. The wings, however, are marked with a smoky-brown in the costal and sub-costal spaces as far as the arculus, and in addition have a golden-yellow tinge from about half-way between the nodus and pterostigma to the apex."

It is very unfortunate that no better females were at hand. I am wholly unable to decide whether the female of *cyanocephala* can be distinguished from *vittata vittata* or not.

The fine specimen which Dr. Laidlaw kindly sent to me for examination and description was also captured near Kandy. It was taken in September and is of slightly larger size than the male recorded by Laidlaw in his paper. Its wings are almost hyaline, slightly yellowish at the tips, the cloudy yellow spot in the anal field of the hinder pair of wings being present, and the pterostigma is black. The nodal index is $\frac{7.15.}{10.11.}\Big|\frac{16.8}{12.10}\ (\frac{46}{43})$.

Epophthalmia vittata sundana subsp. nov. (textfig. 1, 8, 16 and pl. 1 fig. 3).

1871 ♂ Selys, Synopsis Cordulines, pp. 96-97 sep. (*pars*!) (*vittigera*). — Hab.: Java (Immature specimens only).

1906 ♂ Martin, Cat.Coll.Selys, Cordulines, fig. 80 (anal apps. ♂) & Pl. II fig. 13 (insect). (*cyanocephala*). — Unreliable figures, restored from freshly emerged specimen.

Material studied: — 1 ♂ juv. (abdomen and anal apps. deformed by pressure), labeled: Ploem, Java (Selys, yellow label), Epophthalmia cyanocephala Hag. ♂ (Selys, white label), 58 (in lead-pencil on orange label, indicating that it has been drawn for the monograph), Epophthalmia cyanocephala Hag., Rév. Martin 1906 (Martin); 1 ♂ ad., labeled: Batavia, Lantsberg (Selys, yellow label), Epophthalmia vittigera Ramb. ♂ (Selys, white label), Epophthalmia vittigera Rb., Rév. Martin 1906 (Martin); 1 ♂ semiad., labeled: Java, Fruhst. 5 (Selys, yellow label), Epophthalmia vittigera Rb., Rév. Martin 1906 (Martin). — All specimens in Mus. Brussels. — 1 ♀ semiad., labeled: Java Auctie v. Eyndh., unidentified, in Mus. Leiden. — 10 ♂, 1 ♀ ad., W. Java, Buitenzorg, 250 m; Botanical Garden, Victoria-Pond, 14.XII.1929, 21.II, 21.III, 12.IV., 22—24.VIII, 20.IX, 27.IX, 3.X.1930, leg. M.A.L.; 2 ♂ ad., W. Java, Depok, ca. 150 m, between Batavia and Buitenzorg, 14.V.1930, leg. K. B. Boedijn, and 9.XI.1930, leg. M.A.L.

Rather smaller than typical *vittata.* Yellow markings in front of head less conspicuous, those on thorax and abdomen much reduced. Abdomen a trace shorter. Male anal appendages different, of more delicate build and with more pronounced edges, the superiors always distinctly concave when seen in profile.

The following additional description is taken from living or well-preserved specimens:—

♂. — Eyes brilliant emerald-green during life, warm blackish brown in dried examples. Light facial markings clear yellow, those on synthorax and abdomen of a more deeper tint. The spots on abdomen, even in living specimens, not sharply limited anteriorly. Synthorax with metallic green reflex especially vivid along the sutures. Ground-colour of abdomen, up till the end of segm. 7 black, rather buff, thence very dark velvet-brown. Tenth segment again more shining, dark brown. Appendages reddish brown (fig. 8).

Wings entirely hyaline save for a small yellow cloud in the postero-basal corner of hinder pair. Pterostigma deep black. Membranula grayish white fading to blackish apically. Anal loop normal, usually containing ten cells, central cell always present. Nodal index variable between $\frac{43}{35}$ - $\frac{46}{41}$ (antenodals $\frac{14\text{-}16}{9\text{-}12}$, postnodals $\frac{6\text{-}8}{8\text{-}10}$). Accessory genitalia and penis as described on page 29 (fig. 1).

♀. — See tabular description (pp. 44—45). Anal loop with 12—13 cells. Antenodals $\frac{16\text{-}18}{11\text{-}12}$ postnodals $\frac{7\text{-}8}{9\text{-}10}$.

Holotype male (Buitenzorg, 21.III.1930) in Mus. Buitenzorg.

Allotype female (Buitenzorg, 3.X.1930), idem.

The favourite haunt of this beautiful insect is the Victoria pond, the largest of a series of ponds situated near the Governor's palace in the Botanic Garden at Buitenzorg, about 250 m long and from 15—50 m wide.

Some sunny enclosures near the outlets of this pond which, it must be said, continuously supply it with new water from other ponds carrying it off from the opposite side, are partly occupied by a dense growth of aquatic vegetation such as the common Hydrilla verticillata, waterlilies, and large carpetings of Salvinia but these places are always avoided by *Epophthalmia.* It especially prefers the eastern shore where shading and overhanging Nephelium trees only partly transmit the morning rays of the sun. Along this shore the pond is shallow, mud-bottomed and, with the exception of floating islets of Salvinia, is free from any aquatic vegetation, containing thick layers of dead leaves, driftwood, etc. In the dry season the water-mark is sunk so much as to permit large stones to make their appearance.

Here the *sundana* males are found patrolling to and fro the whole grassy border, following anxiously each of its bends, traversing the sunlight openings and disappearing again under the dense shade of the overhanging trees, after few moments returning and sailing past with the same raving speed. The

flight is very swift but not so strong as described for nearctic *Macromia,* and not nearly so as the excessively swift-winged libelluline genera *Tholymis* and *Zyxomma,* usually not higher than one or two feet above the surface of the water and highly characteristic in view of a peculiar and very graceful balancing. Seldom and only when meeting an unfamiliar obstacle they suddenly change their trend, sometimes flying straight out to the middle of the pond, but always soon come back.

The males are on the wing almost the whole year round, since my records are from medio August to the end of May, apparently being absent only during June and July. Only two or three examples are seen at any one time and each male's beat is about 200 m long. Its capture is especially troublesomed by the presence of the very irascible males of *Ictinus decoratus,* a common species along the same pond in the wed season, which are so persistent in pursuing the larger species that it was only occasionally observed during that time.

The males are seen over the water between the morning hours 9 and 11, on cloudless days a solitary specimen may be noticed at about midday, but never in the afternoon.

Evidently the females are very rare and only come to the pond for the act of oviposition. This was observed five times, after having spent many hours on various days at exactly the same course of the pond which is also frequented by the males. The female flies close to the border of the pond, keeping near the surface of the water. When the dark edge under overhanging foliage is reached she chooses a spot in shallow water among partly exposed stones, hardly keeping in check her rapid balancing flight at this point, and nervously tapping the surface of the water with the end of its abdomen from three to eight times with long intervals between each dip, then suddenly turning back and repeating this action from the other side.

On October 3 1930 at last, while collecting at Victoria pond, I very fortunately took my first female during oviposition, and succeeded in catching up about forty eggs from it by loosely holding the insect's thorax and regularly stripping the end of its abdomen against a piece of soft cartoon, placed in a small bottle filled with water, thus allowing the specimen to continue oviposition immediately after capture.

As soon as possible the eggs were then brought to the laboratory for breeding purposes, a report on this investigation being given on pp. 75-77 of the present paper.

E. vittata sundana seems to prefer warm and shallow waters rather more than lakes, as distinguished from *vittigera* which is more frequently met with in temperate regions in larger and deeper pools or lakes. In the surroundings of Buitenzorg both species were found, but hitherto they were not yet seen flying in company of each other.

The exact dates on which oviposition was observed are: — 15.XI.1929, 12.IV, 23.VIII, 24.VIII and 3.X.1930.

Epophthalmia australis HAGEN 1867 (textfig. 9 and pl. 1 fig. 4).

1867 ♂ Hagen, Not.b.Stud.BRAUER's Novara-Neur., Verh.zool.bot.Ges.Wien, 17, pp. 61-62. — Hab.: Celebes.

1868 BRAUER, Verzeichniss Neuropt., II, Verh.zool.bot.Ges.Wien, 18, p. 742 (*Macromia*). — Same habitat.

1871 ♂ Selys, Synopsis Cordulines, pp. 98-99 sep. — Hab.: Moluccas & Celebes.

1878 SELYS, Odon.rég.Nouv.Guinée, Mitt.Zool.Mus.Dresden, p. 295. — Hab.: Celebes (Moluccas not mentioned!).

1901 MARTIN, Odon.Cont.Australien, Mém.Soc.Zool.France, ann. 1901, pp. 227. — Hab.: Australia (*errore*!), Celebes; Borneo (*errore*!).

1906 ♂ MARTIN, Cat.Coll.SELYS, Cordulines, p. 63. — Hab.: Borneo (*errore*!), Celebes, Moluccas.

1914 MARTIN, Gen.Ins., 155, Odon. Lib.Cordulinae, p. 26. — Same habitat.

1915 RIS, Beitr.Odon.Neu-Guinea Reg., Nova Guinea, Zool., 13, 2, p. 123, Cat. — Hab. cited after SELYS.

Material studied: — 1 ♂ ad., (holotype) labeled: Celebes, Limbotto, Rosenberg (printed), and 7. Hag. 65 (written in ink on orange label) in Mus. Leiden; 1 ♂ ad., labeled: Moluques, Lorquin (SELYS, pink label), Epophthalmia australis Hag. ♂ (SELYS), E. australis Hagen ♂, Rév. R. Martin (MARTIN) in Mus. Brussels; 3 ♂ ad., N. Celebes, Paloe, Kalawara, 3, 10 and 12.XII.1912, leg. Dr. L. MARTIN, in coll. RIS; 1 ♂ ad., S. Celebes, Maros, VI. 1929, leg. G. OVERDIJKINK, in Mus. Buitenzorg.

Original description:—

"Ein Männchen stark ausgefärbt aus Celebes. Grösser wie die vorige Art [*E. v. cyanocephala* HAG.], nur die Flügel 52 mill.; das Pterostigma der Vorderflügel etwas kürzer als 3 mill., das der Hinterflügel wenig länger als 2 mill.

Der vorigen Art sehr ähnlich, jedoch Mund und Kopf sehr dunkel röthlich braun ohne gelbe Flecke, die auch seitlich an der Stirne fehlen. Die sehr schmale und kurze gelbe Binde reicht vorn am Thorax nur bis zur Hälfte seiner Höhe und ist gerade.

Leib schwarz, die Basalhälfte des zweiten Segments stark braun behaart, eine gelbliche Binde daselbst kaum angedeutet, seitlich deutlicher. Die gelben Flecke auf dem dritten und vierten Segment kleiner; das Basaldrittel des siebenten Segmentes ledergelb, in der Mitte mit kurzem weitergreifenden Lappen. Leib unten an der Basis und vor der Spitze des Segments rothbraun. Appendices wie bei *E. vittata*, die untere breiter als bei der vorigen Art.

Lamina anterior spitzer, mehr erhaben, weniger tief ausgekerbt. Hamulus wie bei der vorigen Art. Flügel wie bei der vorigen Art, jedoch der Analwinkel der Hinterflügel schmäler, viel weniger abgerundet; das Pterostigma kleiner."

This rather short description is sufficiently characteristic to distinguish *australis* from the other species of the genus since all its important features are summarized in the same. Differences in the shape of the anterior genital lamina, as noted by HAGEN, are very slight and, from my experience, rather dependent on the optic angle from which it is looked at by the observer. Judging from the fairly rich material which I was able to compare, *australis* is a very uniform species and no serious difficulties arose in separating it at once from *vittigera* or from *vittata cyanocephala.*

It is dark long-winged species of compact building with a large head and reduced dull orangish markings on thorax and abdomen, in old males the upper part of the head and the thorax being of a very brilliant metallic blue or purplish colour. SELYS's description of the male from the Moluccas is very good, though the present state of preservation of the insect indeed leaves to be desired. The three specimens from N. Celebes do not differ in any way from the two others and such is the case with the single male from Maros, in the extreme south of the island.

All literature dealing with this species appeared since the date of the Synopsis is of no value as it refers to other species of the genus or merely contains quotations from the two original descriptions.

Some neural characters may still be of use:—

Nodal indices: Celebes (Type) $\frac{8.16.}{11.11.}\Big|\frac{17.8}{11.11}$ $(\frac{49}{44})$, Moluccas $\frac{10.18.}{11.11.}\Big|\frac{18.8}{12.10}$ $(\frac{54}{44})$, Maros $\frac{8.15.}{10.10.}\Big|\frac{16.8}{12.10}$ $(\frac{47}{42})$, Kalawara $\frac{7.17.}{10.11.}\Big|\frac{17.8}{11.9}$ $(\frac{49}{41})$, $\frac{7.18.}{11.11.}\Big|\frac{18.8}{12.10}$ $(\frac{51}{44})$, $\frac{8.17.}{12.11.}\Big|\frac{16.8}{10.10}$ $(\frac{49}{43})$. Number of cells in the anal loop 8—11, with or without central cell. The pterostigma is decidedly smaller than in any of the other members.

E. australis has never been figured in any way. Perhaps this is the reason why it was so often confused with its nearest ally, viz., *vittigera.* A coloured drawing of the entire insect may give an idea of its general appearance, the outline figures of the anal appendages may, I hope, be of some assistance too.

Epophthalmia vittigera (RAMBUR) 1842 (textfigs. 10, 11, 13, 14).

1842 ♀ **Rambur, Hist.nat.Insectes, Névroptères, p. 140 (*Macromia*). — Hab. ign.**

1871 ♂♀ **SELYS, Synopsis Cordulines, pp. 96-97 sep. (*pars*!). — Hab.: Java (Exx. juven.vide sub *vittata sundana*).**

1904 **MARTIN, Mission Pavie, Zool., Névropt., p. 211. — Hab.: Java, Tonkin, Assam.**

1906 ♂♀ **MARTIN, Cat.Coll.SELYS, Cordulines, pp. 62-63 (*pars*!). — Hab.: Java, Assam, Borneo (Exx.juven.vide sub *vittata sundana*).**

1911 ♂♀ **Ris, Libellen v.Sintang, Borneo, Ann.Soc.ent.Belg., 55, pp. 248-251, fig. 14 (wing-photograph ♂ Perak), 15 ab (anal apps. ♂, Sintang), 16 ab (genit. ♀, Sintang) (*australis*). — Hab.: C. W. Borneo; Perak.**

1913 **LAIDLAW, Proc.Zool.Soc.London, 1, pp. 69-70 (*australis*). — Hab.: N.Borneo.**

1914 ♂ **Martin, Gen.Ins., 155, Odon.Lib.Cordulinae, p. 26, Pl. 2 fig. 15 (insect). — Hab.: Java, Borneo, Assam.**

1920 LAIDLAW, Contrib.Drag.Fauna Borneo, IV, Proc.Zool.Soc.London, p. 317 (*Azuma australis*), p. 318 (*A. vittigera*). — Hab.: Borneo, teste auct.
1921 ♂♀ FRASER, Indian Drag., X, J. Bombay N.H.Soc., 27, pp. 680-681 (*pars*!). — Hab.: Java (Assam, Borneo). Descr. teste SELYSi.
1926 FRASER, Notes Drag. Dutch East Indies, etc., Treubia, 8, livr. 3-4, p. 472 (*Azuma*). — Hab.: Java, Burma.
1930 HINCKS, Sarawak Museum Journ., 4, 1, no. 12, p. 53. — ♂♀ Sarawak (record).

Material studied: — 1 ♂ ad. (terminal abd.-segm. wanting), labeled: Batavia Lantsberg (SELYS, yellow label), unidentified; 1 ♂ ad., labeled: Java (SELYS, yellow label, remainder illegible), Epophthalmia vittigera R. ♂ (SELYS, yellow label), vittigera Rambur. 124. ♂ Java (unknown handwriting, on large orange label); 1 ♀ ad., labeled: A (on white square label, probably RAMBUR's type), 125 (printed), Epophthalmia vittigera R. ♀ (SELYS, yellow label), vittigera Rambur. 125. ♀. Java (unknown handwriting, idem); 1 ♀ ad., labeled: Java Fr. (SELYS, square yellow label), Epophthalmia vittigera Rb., Rév. Martin 1906 (MARTIN); 1 ♀ juv. (head and abd.-segm. 5—10 wanting), labeled: Java, par M. Pulsk (SELYS, yellow label), Vittigera R. (SELYS, orange label); 1 ♂ ad., labeled: Vanderh. Timor (SELYS, yellow label), Vittigera R. (SELYS, orange label), Fig. Gen. Ins. (printed in blue), Epophthalmia vittigera Rb., Rév. Martin 1906 (MARTIN). — All in Mus. Brussels. — 1 ♂ ad., W. Java, G. Gedeh, Tjibodas, 1450 m, IX.1895, I. Z. CANNEGIETER leg. (E. vittigera Ramb., det. RIS; 1 ♀ ad., Java or., MULIÉ; 2♀ in bad condition, Java, MULLER; 1 ♂ juv., W. Sumatra, Padang Pandjang, ROLLE vend. 1909; 1 ♂ ad., Br. N. Borneo, Mt. Marapok, Dent Province, leg. G. (E. vittigera Ramb., det. RIS). — All in Mus. Leiden. — 1 ♂ ad., in spirit, Malacca, Singapore, 24.VII.1909, leg. SCHWINGHAMMER, in Mus. Hamburg. — 1 ♂ ad., def., Malacca, Perak, F. M. S. Perak Mus., Tai Ping (Azuma australis, det. LAIDLAW); 1 ♂ juv., Malacca, Kuala Lumpur (Id.); 1 ♀ ad., Malacca, Ulu Pandau, Singapore, VIII. 1921 (Id.); 1 ♂ ad., Br. N. Borneo, Rebau, leg. J. C. MOULTON (Id.). — All in coll. LAIDLAW. — 1 ♂ ad., W. Java, Buitenzorg, 250 m, 25.IX.1918, leg. W. ROEPKE; 1 ♂ 1 ♀ ad., Centr. W. Borneo, Sintang, 8.III.1910 & 3.XI.1909. leg. L. MARTIN (E. australis Hag. forma, det. RIS, revision after 1911!). — All in Coll. Dr. F. RIS. — 2 ♂ ad., Palawan, Tay Tay, 19.IV. & La Laguña, 12.V.1913, JANSON vend., in coll. K. J. MORTON. — 1 ♀ semiad., W. Java, Depok, between Batavia and Buitenzorg, ca. 100 m, 4.V.1930, G. HEINRICH leg.; 1 ♀ ad., W. Java, Preanger, Garoet, 700 m, 16.XII.1930, W. C. VAN HEURN leg., both in Mus. Buitenzorg.

I seriously regret not being able to include a transcription of RAMBUR's first report on this species, although the conviction grows upon me that the female in the Brussels Museum, determined by DE SELYS as *vittigera* and originally bearing a very old label with 'A' in reality is the type, and that afterwards somebody else may have added a second label with Java as indication of habitat. This, however, is only a supposition and it seems at any rate

useful to copy SELYS's description of *vittigera* as it refers to the first known examples of which the habitat is known with certainty. It runs as follows:—

"Abdomen ♂ 50—53; ♀ 57—60. Aile inférieure ♂ 48—51; ♀ 51—54.

Ailes hyalines (chez le ♂ un nuage jaune pâle à l'angle anal et l'extrême base portant une marque brune rudimentaire aux supérieures, mais occupant aux inférieures l'espace entre la costale et la médiane jusqu'à la 1re antécubitale. — Chez la ♀ la marque brune mieux distincte aux supérieures et formant aux inférieures une bande entre la costale et la sous-médiane atteignant la 3e antécubitale; enfin le 5e terminal des ailes supérieures presque toujours lavé d'ochracé sale). Membranule grise, plus foncée contre le bord anal; ptérostigma brun noirâtre, surmontant 1½ à 2 cellules (long de 3 mm); 15—20 antécubitales, 7—8 postcubitales; 3—4 hypertrigonales; 5—7 médianes; 3 cellules postrigonales, puis 2 rangs. Réticulation noirâtre, costale à peine jaunâtre jusqu'au nodus.

D'un brun noirâtre, varié de jaune. Lèvres et face brun roussâtre, une ligne basale transverse sinueuse, interrompue au milieu, et le fin bord latéral au nasus, jaunâtres. Dessus du front bleu acier métallique (chez la ♀ jeune avec une tache médiane basale [error?] et une de chaque côté du front contre l'oeil, jaunâtre, pâle). Thorax brun noir à reflets bleuâtre métallique. Les sinus antéalaires en avant, une raie antéhumérale étroite, droite, ne les touchant pas et sur les côtés une médiane étroite faisant le tour du thorax entre les ailes, jaunes. Abdomen cylindrique, renflé à la base, un peu épaissi aux 6e—10e segments, noirâtre, annelé de jaune ainsi qu'il suit: un anneau submédian étroit aux 2—6e segments, presque interrompu en dessus, excepté au 2e; l'anneau aux 7e et 8e est plus près de la base, et au 8e il n'est pas interrompu. Pieds noirâtres, fémurs bruns.

♂ 10e segment un peu bossu à la base. Appendices anals brun noirâtre; les supérieurs un peu plus longs que le dernier segment, un peu courbés en tenailles, épais; le bord externe est droit dans sa première moitié, puis forme un coude à dent anguleuse; le bout mousse. Appendice inférieur un peu plus long que les supérieurs, triangulaire à peine recourbé en haut, le bout un peu tronqué.

♀ Les raies et anneaux jaunes un peu plus larges. Appendices anals noirâtres, coniques, très-pointus, plus courts que le 10e segment, qui est aussi long que le 9e. Écaille vulvaire paraissant consister en deux lamelles en forme de feuilles de laurier rapprochées, aissi longues que la moitié du 9e.

Jeunes. Vestige de deux marques pâles à la base de la lèvre supérieure. Les anneaux jaunes de l'abdomen plus larges aux 4—7e segments (chez le mâle la base des ailes sans marque brune, le 10e segment et les appendices anals brun jaunâtre) [error, = *vittata sundana*].

Patrie: Java. (Coll. Selys.).

N.B. Voir la comparaison des cinq espèces voisines à l'article de la *vittata* dont la *vittigera* n'est peut-être qu'une race locale."

I may especially point to the fact that the somewhat aberrant shape of the male anal appendages clearly finds expression in this description, the darkly

spotted wing-bases and the wholly metallic upper part of the frons being also mentioned. The single juvenile female in Mus. Brussels lacks its head so that I can not say whether very young specimens have a light spot on the dorsal surface of the frons or not. In none of the examples examined by me a light point or spot is perceivable. This lets me suppose that SELYS's observation is due to a mistake.

As already hinted at SELYS's remarks on the young males refer to *vittata sundana*.

The more darkened specimens from Sintang in Borneo, both male and female, were excellently described by RIS in 1911, together with a male from Perak. The figures accompanying that description are reproduced in the present paper and show at a glance that RIS was not right in referring his insects to *australis*, a species which has not been found in Borneo and is not likely to occur there. There is some variation in the relative extension of the yellow or brownish spots all over the body, the intensity of the dark ground-colour and the shading of the metallic reflex being also a little different when comparing specimens from different habitat. As to that, I may especially point to a very strikingly pronounced parallelism between *Macromia cincta* RAMB. and *Epophthalmia vittigera*: in both species the yellow ornaments on the body gradually become more reduced in examples from the eastern parts of their distribution, the golden-brown spots at the wing bases and the intensity of the remaining dark colours at the same time becoming more extended and deepened. There is much evidence this development of melanism being influenced by the same — probably climatic — factors and that the same ways of distribution were followed.

The species will at once be recognized when looking at the splendid picture of the male insect in R. MARTIN's Cordulinae, of WYTSMAN's 'Genera Insectorum', drawn from the Timor male in the Brussels Museum.

E. vittigera is apparently the least rare member of the genus throughout the whole of its occupied area. MARTIN adds Assam and Tonkin to its habitat, the last mentioned country being omitted by the same author in a later paper, and FRASER (loc. cit.) says that he has seen specimens from Burma. There is no reason whatever in calling these statements in question but I am wholly unable to fortify them.

My own experiences with this species are very poor and so far I had no opportunity of taking any specimen myself, although we found two skins at lake Koeripan, north of Buitenzorg, and I observed a single male patrolling the steep border of lake Tjigombong between Buitenzorg and Soekaboemi. This was flying above open water and could easily be identified from the boat with my glass, but its capture failed as I was much engaged at the same time in catching the red-bodied *Urothemis* and *Rhodothemis*, also occurring there in some numbers. It was further repeatedly seen by Mr. DRESCHER along lake Padalarang, north of Bandoeng but never could it be taken according to its only exceptionally coming within the reach of an insect net. The larva is described and figured below.

LARVAE.

The following notes are based on a rather limited number of *Epophthalmia* larvae, partly sent to me for identification by Dr. E. TITSCHACK of the Hamburg Museum, partly lent from Dr. LAIDLAW's collection. The two skins which I refer to *E. vittigera* RAMB., were taken by us during a visit to a lake not far from Buitenzorg, Java.

The peculiar and highly specialized labium has already been dealt with by CABOT (loc. cit., 1890) and Miss BUTLER (loc. cit., 1904) so far as *elegans* is concerned in his "Biology of Dragonflies" (1917), TILLYARD made use of the same species in giving a figure of the lateral lobe of the labium which, however,

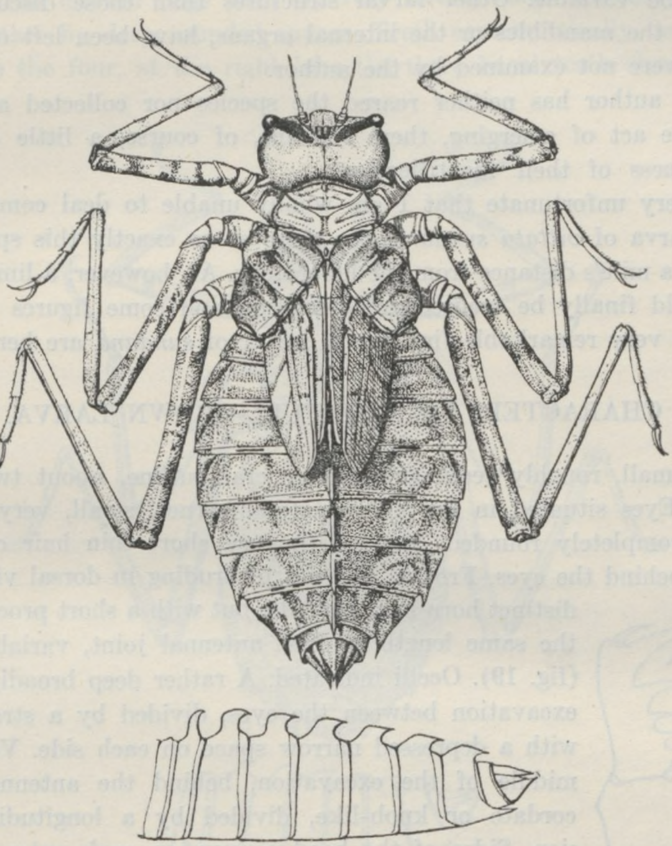

Fig. 17. ***E. elegans*** **BRAUER, ultimate larval instar, Fo Kien, China (Mus. Hamburg). Below left lateral view of abdomen, showing dorsal hooks.**

is not correct, the most distally situated tooth being omitted in the figure, probably because exactly this tooth often escapes notice in consequence of the strongly bent tip of the lobe in natural position (cf. also CABOT's figure!). In all my examples of *elegans*, as well as in the other species, this tooth is equally developed and only little variable in size, like the other ones.

Besides, special attention may be called to the very close and rather unexpected similarity of the labia in the three examined species. While making some illustrations for this purpose I was much surprised to find them so perfectly agreeing that no useful differences could be detected, — the more reason why not placing the sino-japanese *elegans* in a separate genus.

The very full description of the larva of *elegans* as offered by CABOT, is, for the most part, also applicable to the other species of the genus. Only few additions or omissions were necessary. The figures given are fairly good although the somewhat distorted attitude of the entire insect on pl. 1 (fig. 1) does not give a perfect idea of its true appearance.

In the next given key only those characters are employed which do not appear to be variable. Other larval structures than those discussed in the text, as i.e. the mandibles or the internal organs, have been left out consideration and were not examined by the author.

As the author has neither reared the species nor collected any of them while in the act of emerging, there remains, of course, a little doubt as to the correctness of their identification.

It is very unfortunate that I am wholly unable to deal completely with the adult larva of *vittata sundana*, the more so as exactly this species breeds within half a mile's distance from the laboratory. As, however, a limited number of eggs could finally be secured, a description and some figures of both the egg and the very remarkable first larval instar of *sundana* are here appended.

CHARACTERS OF THE FULL-GROWN LARVA.

Head small, roughly rectangular in general outline, about twice broader than long. Eyes situated in the antero-lateral corner, small, very prominent, knob-like, completely rounded. Head with very short thin hair on the sides below and behind the eyes. Frontal line not protruding in dorsal view, without distinct horn in the middle but with a short process of about the same length as first antennal joint, variable in shape (fig. 19). Ocelli indicated. A rather deep broadly triangular excavation between the eyes, divided by a straight suture with a depressed narrow space on each side. Vertex in the middle of the excavation, behind the antennae, inflated cordate or knob-like, divided by a longitudinal depression. Sides of the head convex, on each outer hind angle, which is always completely rounded, a nipple-shaped projection of slightly variable length. Antennae seven-jointed, about as long as the head; the two basal joints thickest, the first cylindrical, long, the second half as long and much narrower, rather rounded at tip. Remaining joints long and extremely thin: the third as long as the two basals together or slightly shorter; fourth joint about twice shorter than

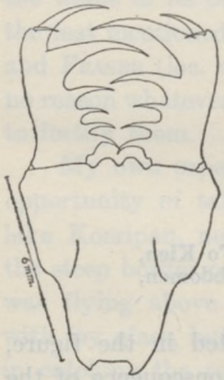

Fig. 18. *E. elegans* BRAUER, interior view of labium.

third, of equal length or a trace shorter than the fifth joint; sixth and seventh joints as long as fifth or distinctly longer (fig. 23).

Labium of very large size and extraordinary shape, extending between the middle legs as far as an elevated transverse ridge between the hind legs; basal part long with two strong, rounded, longitudinal ridges underneath, enlarged anteriorly forming in the middle at its free margin two smooth and rounded lobes, divided from each other by a rounded depression. Lateral lobes strongly developed, of very peculiar shape, comb-like, about as long as the basal parts, rather narrow and but incompletely interlacing. The interior edge with six very strong hook-like teeth, separated from each other by deep rounded spaces. Teeth asymmetrically developed. At the left lobe the four, at the right lobe the three basal teeth shortest and of

Fig. 19. *E. elegans* BRAUER, anterior part of head, dorsal view. Last joints of antennae cut off.

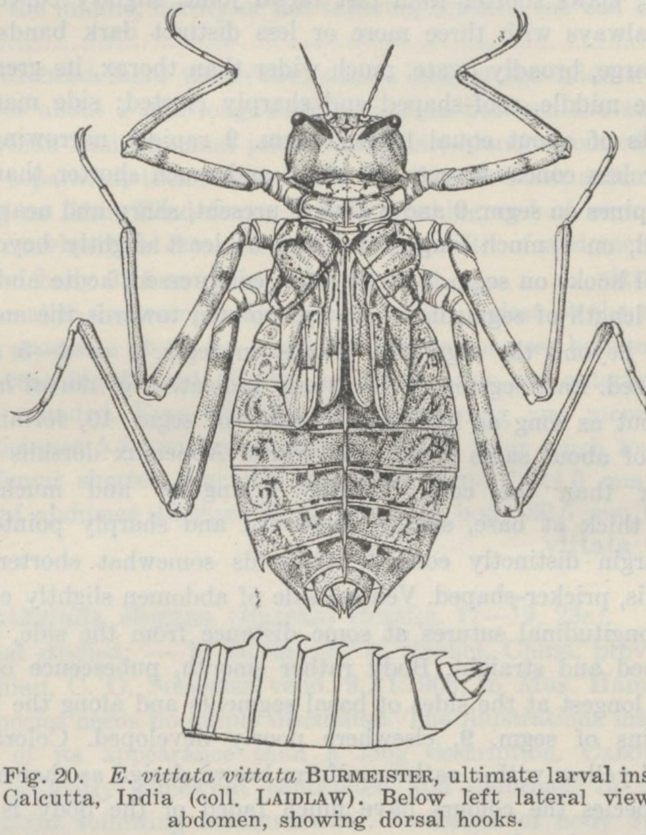

Fig. 20. *E. vittata vittata* BURMEISTER, ultimate larval instar, Calcutta, India (coll. LAIDLAW). Below left lateral view of abdomen, showing dorsal hooks.

subequal length, the first (basal) tooth swollen at base, crenulated interiorly. The fifth tooth of left and right lobes longest of all, weakly serrate interiorly, sixth tooth longest on left lateral lobe. The apical half of all teeth black.

When closed the first (basal) pair of teeth crossing each other. All setae absent. Movable hook spine-like, very short (figs. 18, 21, 29).

Prothorax rather narrower than the head; an elevated ridge in front, and an elevated ridge around the whole hinder part, which is traversed by another elevated ridge. Posterior ridge protruding on either side, giving off a bluntly pointed process. Stigma large. Dorsal parts of synthorax subquadrangular or rather trapezoidal, divided into three oblique, convex and somewhat angular portions.

Wing-pads reaching to a level between fifth and sixth segment or to the end of fifth, lying parallel to each other on the back, conspicuously spotted with black. Venation clearly visible in freshly moulted examples (fig. 20).

Legs widely distant, strong, much flattened and very long. Hind femur reaching at least to the end of segm. 7, tibia about same length as femur, tarsus half as long as tibia. First tarsal joint very short, the two others long, of equal length; claws shorter than last tarsal joint, slightly curved, without teeth. Femora always with three more or less distinct dark bands.

Abdomen large, broadly ovate, much wider than thorax, its greatest width at or before the middle, roof-shaped and sharply crested; side margin sharp. Middle segments of about equal length, segm. 9 rapidly narrowing, its hind margin more or less concave, segm. 10 small and much shorter than the foregoing. Lateral spines on segm. 9 and 8 always present, sharp and nearly straight, that on 8 small, on 9 much longer, reaching at least slightly beyond end of segm. 10. Dorsal hooks on segm. 3—9 or 4—9, compressed, acute and connected with the whole length of segments, their tips pointed towards the end of abdomen, extending beyond the segments. Hooks on segm. 3 or 4—5 cylindrical, more or less raised. Last segment without any indication of dorsal hooks. Anal appendages about as long as half the diameter of segm. 10, forming a thick short pyramid of about same length and width. Appendix dorsalis as long or slightly shorter than the cerci, broadly triangular and much flattened dorsally; cerci thick at base, slightly upturned and sharply pointed at tips, their outer margin distinctly concave. Cercoids somewhat shorter than the appendix dorsalis, pricker-shaped. Ventral side of abdomen slightly convex with two incurved longitudinal sutures at some distance from the side, these side-portions flattened and straight. Body rather smooth, pubescence of abdomen short and thin, longest at the sides of basal segments and along the lateral and posterior margins of segm. 9, elsewhere poorly developed. Coloration light ochreous or dull yellow with a rather uniform brown design as shown in fig. 20. In the other species the colours have much faded or the body is somewhat encrustated with mud or loam.

Total length of the body from 32—35 mm.

The above, description is applicable to the larvae of *E. elegans, vittata vittata,* and *vittigera.*

Key to the species. [1])

1. Dorsal hooks present on segm. 3—9 of abdomen, that on 3 long and slender, raised straight upwards, those on 4—9 with their basal portions long, much raised anteriorly and strongly nodding, their upper distal margins straight. Greatest width of head situated in the middle. Nipple-shaped processes short, about 0.5 mm long. Distance between the eyes 6.2 mm. Abdomen broadly ovate, greatest width much before the middle, from segm. 6 tapering, rather pointed. Hind femur short, reaching to end of segm. 7, its length (incl. troch.) 13.5 mm. Total length of body 34.8—35.2 mm. (figs. 17—19, 23c). .... **elegans** (Brauer).

—. Dorsal hooks present on segm. 4—9 of abdomen only, those on 4 and 5 sub-equal, slenderer and more erect than the others which are rather low and not raised anteriorly, their upper margins being evenly rounded towards the much pointed tips. Abdomen ovate, widest at or slightly behind the middle, hardly or not tapering towards the end and less pointed .... 2.

2. Shape of head more transverse, widest behind the middle. Nipple-shaped processes about 1 mm long. Frontal process between the antennae slightly longer than first antennal joint, triangular, bluntly pointed in front. Eyes widely separated, their distance 6.0 mm broad. Sixth antennal joint about as long as fifth. Hind femur almost reaching end of segm. 8 (not so far in the exuviae!), 14.8 mm long. Greatest width of abdomen 13 mm. Total length of body 33.5 mm (figs. 23b, 28—29). .... **vittigera** (Ramb.).

—. Head smaller and comparatively less broad, widest at the middle. Nipple-shaped processes about 0.6 mm long. Frontal process between the antennae small, reaching to end of first antennal joint, its anterior margin completely rounded. Eyes slightly more protruding and more approximated, their distance 5.5 mm broad. Sixth antennal joint much longer than fifth. Hind femur shorter, reaching to end of segm. 7, 14.0 mm long. Greatest width of abdomen 13 mm. Total length of body 32.5 mm (figs. 20—23a). **vittata vittata** Burm.

Epophthalmia elegans (Brauer) (textfig. 17—19, 23c).

Material studied: — 14 larvae ult, in alcohol, China, prov. Fo-Kien, and idem, Futshiau, C. G. Siemssen vend. 9.XI.1906, in Mus. Hamburg.

This species needs no ample discussion. The illustrations may give a better impression of its appearance than a long description. Cabot's larva from Canton is evidently somewhat contracted and deformed in the liquid. The author gave the following measurements: — length of body 31 mm; breadth 15 mm; legs 35 mm.

[1]) I may emphatically remind that the differences employed in this key are based on a very limited number of specimens, except as regards *elegans*, where practically no deviations were found while measuring about a dozen of specimens. Yet I consider this key to be only an indication for future research.

Epophthalmia vittata vittata BURM. (textfig. 20—23a).

Material studied: — 1 larva ult, in alcohol, labeled: India, Calcutta, Azuma spec. (LAIDLAW's hand), in coll. LAIDLAW.

This specimen most probably belongs to continental *vittata* and is well distinguished from the Malaysian nymphs mentioned below, although the differences are slight and only perspicuous when comparing them with the others. Among other characters given in the key the differently shaped head will serve to its recognition. The figure of the hind wing is a copy of that given by LAIDLAW in his paper "The Dragonfly Fauna of the Malay Peninsula", in the Journ.Mal.Branch of the Royal Asiatic Soc., I, 1923, pt. 2. In that work it was offered as an example of the tracheation of an anisopterous dragonfly. The author's explanation of the different veins runs as follows:—

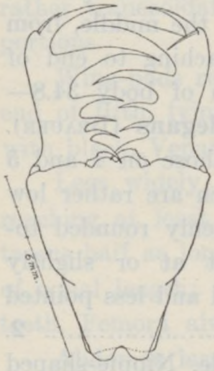

Fig. 21. *E. vittata vittata* BURMEISTER, interior view of labium.

"C. Anterior margin of wing; note that there is no costal trachea.

Sc. Subcostal trachea.

M + R. Trunks of median and radial trachea, running together.

Cu + A. Trunks of cubital and anal trachea, running together.

R. Distal part of radial trachea. Rs 'Radial sector'.

M1 M2 M3 M4. Branches of median trachea.

Cu1 Cu2. Branches of Cubital trachea.

N. Nodus. Pt. Pterostigma. T. Triangle. ST. Supra triangle.

Arc. Arculus. Ac. Anal crossing. AL. Anal loop. Br. Bridge-vein. Rspl. Radial supplement.

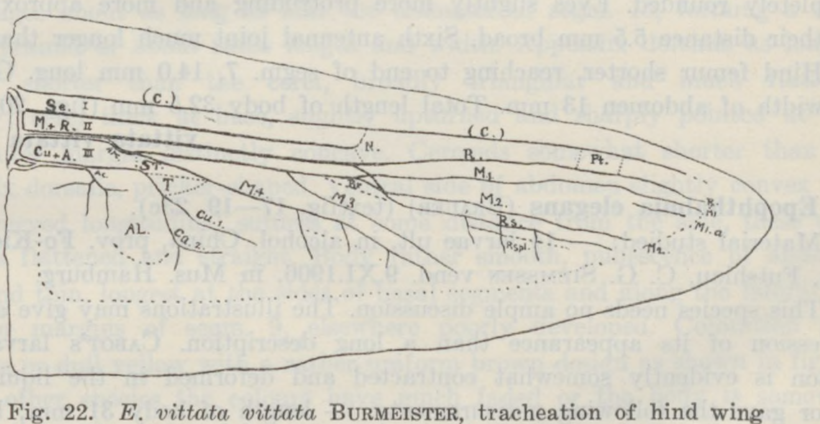

Fig. 22. *E. vittata vittata* BURMEISTER, tracheation of hind wing in ultimate larval instar, Calcutta, India (After LAIDLAW).

Note. Important *veins* not pre-formed as tracheae are indicated by dotted lines. The outline of the whole figure marks the outline of the larval wing case, the anterior margin of the wing is shown at C and the posterior margin is

indicated by a dotted line. I. Costal space. II. Subcostal space. III. Median space.

This figure may be taken as representing the tracheation of the typical anisopterous wing. Note especially the way in which Rs crosses M1 and M2 where these fork from each other, and how the bridge-vein (Br) carries it back on to the trunk of the media." (pp. 332—333).

The remaining wing-pads were used for the same purpose by the author of the present paper, and I can wholly affirm the correctness of LAIDLAW's interpretation of the terminology of the veins.

In this larva the natural design is as excellently demonstrated as if the specimen were alive, and I am strongly of opinion that the last moult took place at most a few weeks before its capture.

In 1919 Col. FRASER published some notes on an *Epophthalmia* larva from Poona, India, taken from "running streams amidst curtains or masses of water-weed" (loc.cit. p. 460, sub *frontalis*), but, as is also applicable to nearly all other species discussed in the above mentioned paper, the description given is rather short and incomplete, the outline-drawing of the insect itself as well as that of the labium being of little use to the student. Apparently FRASER has not consulted CABOT's work on the larval stage of Corduliinae, and it would seem to me that the author's remarks on p. 459 of his paper are rather premature: — "The curving and cupping of the antlered lobes of *Epophthalmia* foretells the evolution of the cupped mask of the Libellulines. One has only to web in the spaces between the elongated teeth to obtain such a mask. This bears out the theory that the Libellulinae are an offshoot of a Corduline stem."

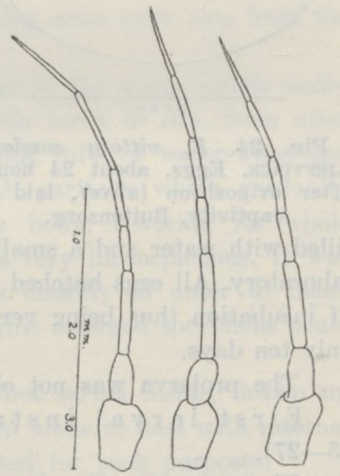

Fig. 23. *Epophthalmia* spp. Antennae in ultimate larval instar of *vittata* (Calcutta), *vittigera* (Deli, Sum.), and *elegans* (Fo Kien, China).

Just the reverse, I believe the peculiar transformation of the mask during ontogeny rather points to a recently adapted, very capricious and p r o p e r specialization.

Epophthalmia vittata sundana LIEFT. (textfig. 24—27).

T h e e g g. — As already stated on p. 63 of this paper the eggs are deposited in the common Libellulid manner, viz. by dropping them freely into the water during flight, merely by striking the tip of the abdomen from time to time against the water's surface. *Epophthalmia* thus practises e x o p h y t i c oviposition. It is a well-known fact that this method of oviposition is closely correlated with the shape of the egg, this always being of a more or less rounded form. However, in certain Libelluline genera ovipositing in the same way, the eggs are distinctly elongate, in the Trameine genus

Zyxomma for instance even more so than in many zygopterous dragonflies practising endophytic oviposition. In *Epophthalmia* the eggs are also strongly ovate and it is very difficult to say whether the elongate form of the eggs may be considered as a remains of earlier conditions or is the result of high specialization.

In my papers on the life-history of *Procordulia* and *Zyxomma petiolatum* I hope to come back on the subject.

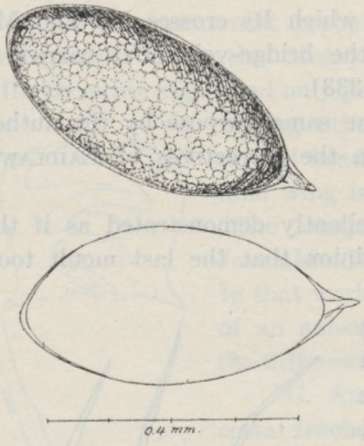

Fig. 24. *E. vittata sundana* LIEFTINCK. Eggs, about 24 hours after oviposition (alive), laid in captivity, Buitenzorg.

The egg is extraordinary small for such large an insect, 470—500 μ long, 240—250 μ broad, light yellowish in colour, strongly pedicelled, and almost devoid of a gelatinous shelter when freshly deposited. After about 48 hours this protecting layer had become much swollen and each egg was now tightly fastened on to the substratum (vide p. 63). This was cut to several pieces, each of them being placed in small petri-dishes filled with water and a small quantity of green algae, and finally kept in the laboratory. All eggs hatched successfully between October 13 and 15, the time of incubation thus being very short, only ten days.

The prolarva was not observed.

First larval instar (fig. 25—27).

The young specimens were removed from the egg dish and placed separately in other petri-dishes, which were kept in a shaded part of the laboratory in front of an open window, and were exposed for half an hour each day to the sunlight.

No food was given during the first instar, because plenty of Protozoa and Rotatoria were involuntarily present of their own accord amidst plots of algae, small pieces of wood, etc. Several specimens died and many of them disappeared by some unknown means from the covered dish in which they were kept. On Nov. 7 only three in all were still living, but apparently in good condition. A few

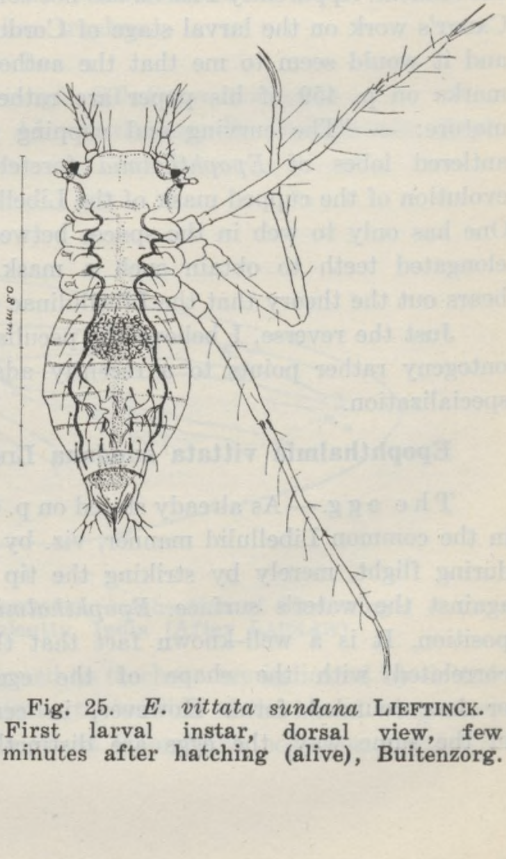

Fig. 25. *E. vittata sundana* LIEFTINCK. First larval instar, dorsal view, few minutes after hatching (alive), Buitenzorg.

days later, on Nov. 11, two exuviae of the first instar were found but the moulted specimens were not discovered, and again shortly afterwards the remaining larvae were absent altogether. Thus the second larval instar was not observed at all and the experiment found an unfortunate and early ending.

Apart from its sluggishness and its minute size, the young larva is greatly distinguished by its very effective means of protection.

From each side of the upper part of the head a strongly projecting outgrowth of the vertex can be easily observed, which, on its slightly branched apex bears two greatly modified setae. These setae are thick and short, and are divided into numerous rather closed spines. Moreover, each of the thoracic pleurae is provided with a single divided seta which strongly reminds the needled and adhesive fruits of Bidens; rather similar complex setae arise also from the dorsum of abdominal segments 8—9.

The significance of these peculiar modifications of the body-wall is easily understood when observing the young *Epophthalmia* larva *in situ.* Soon after emergence the little creatures hide themselves among tufts of water-weed and algae, involuntarily picking up all kinds of small particles which gradually become attached to the spinulose setae of the body, covering its whole surface in such a manner as to render the insects very inconspicuous. It was found rather difficult to clean the older nymphs entirely in order to make satisfactory drawings of them, and therefore only just emerged specimens could be used.

The following is a brief description of the first larval instar, drawn up from three living specimens. No attempts have been made to deal with internal structures, as the material available was too limited for such purposes.

The newly hatched larva is an extremely small, very sluggish, hyaline creature with enormously prolonged legs which are spread almost straight out when slowly wandering about on the bottom of its domain.

When looked at from aside, the body appears somewhat curved, the head being distinctly upturned so that the frontal part of it and the labium are turned towards the observer. The apex of the abdomen is very movable, and can be freely retracted or telescoped within the preceding segments.

The head is large, more than 1½ times as wide as long, almost rectangular in shape. Eyes widely distant, slightly projecting in front and situated at the anterior edge of the head. Epicranium very distinct, strongly elevated and well-separated laterally from the postocular lobes; on each lateral margin this part of the head bears a strongly projecting off-shoot, directed vertically upwards and divided apically into two short side-branches which, themselves, are provided with an apparently movable, somewhat brush-shaped seta of very singular appearance (fig. 26).

L a b i u m. — Mentum rectangular, very weak, not projecting in front, reaching as far back as end of prosternum, about 0.2 mm broad at base, 0.28 at apex, with its apical margin nearly straight. Setae absent. Lateral lobes subtriangular, their exterior border strongly curved and the mesal margin with six large and pointed teeth, the interspaces being broadly rounded. First crenation from the outside divided. Movable hook short and rather stout. Lateral setae distinct, 1.1 in three specimens examined, situated well beyond the middle of the margin (fig. 27).

Fig. 26. *E. vittata sundana* LIEFTINCK. Dorsal view of left lateral portion of head, in a newly hatched larva, showing branched frontal process, eyes, and base of antennae. Below, a divided seta of metanotum in the same specimen (drawn to scale). Buitenzorg.

T h o r a x robust, almost square, very slightly broader than head, the segments of subequal length. Each of the thoracic segments possesses at dorsum, on the pleurae, a single short, somewhat cupula-shaped seta, which is strongly hollowed at apex, its margin being so deeply indented as to form a ring of sharp spines (fig. 26a). Only one pair of simple setae on dorsum of separate segments. Legs excessively long and slender, the hinder leg being much longer than the body, measuring about 1.1 mm.

A b d o m e n short and weak, longer than head and thorax taken together, widest in the middle. First three segments very short, seventh to ninth longest, tenth shorter and sometimes wholly retracted within the foregoing segment. Dorsum of segm. 2—9 with three pair of long setae, the median two increasing in thickness and decreasing in length from before backwards. On 6—7 these setae are spine-like, on 8—9 each is broadened towards the end but shorter and, besides, are distinctly forked at tip. Segm. 10 only with two small median forked setae on dorsum.

Fig. 27. *E. vittata sundana* LIEFTINCK. Interior view of left lateral lobe of labium, in a newly hatched larva, showing lateral seta, apical teeth, and movable hook. Buitenzorg.

Anal appendages and rectal valves of large size when wholly stretched, very retractile. Appendix dorsalis elongated triangular with apex abruptly truncated, bearing two setae of equal length. Cerci at first straight, then strongly curved outwards, much projecting beyond appendix dorsalis. Anal appendages, excepted anal valves, with long setae.

Total length of living specimen	0.9 — 1.0 mm.
Width of the head	0.3
Length of abdomen, incl. apps.	< 0.6
Greatest width of the same	< 0.4

Epophthalmia vittigera (RAMB.) (textfig. 23b, 28—29).

Material studied: — 1 larva ult, in alcohol, labelled: Deli, Sumatra, W. BURCHARD leg., ded. 12.X.1895, in Mus. Hamburg. — 2 exuviae, Java occ., lake near Koeripan, west of Depok, 150 m, between Batavia and Buitenzorg, 20.VII.1930, leg. Miss TERA VAN BENTHEM JUTTING, in Mus. Buitenzorg.

Fig. 28. *E. vittigera* RAMBUR, ultimate larval instar, Deli, Sumatra (Mus. Hamburg). Below left lateral view of abdomen, showing dorsal hooks.

The comparative description is from the single alcoholic Sumatran larva and from the two exuviae collected at lake Koeripan. The skins were found attached to a dead treestump fallen into the water on shore, about one foot above the water's surface. I have no specimens of this species taken emerging and not a single *Epophthalmia* was observed by us at the time of picking up the exuviae, but I am almost sure that they belong to *vittigera* as this species was found near Depok. In addition, their very striking resemblance to the nymph from Deli, in N. E. Sumatra, which no doubt is a true *vittigera,* strengthens this opinion, the more so since the shape of the head as well as the ratio of length of the antennal joints are exactly identical in our material. In spite of all that, the smaller species *vittata sundana* may also occur in the same place, but I suspect its larva will turn out to be rather different.

Both rather thin-skinned exuviae are evenly covered with a layer of rusty-coloured loam, wholly making disappear the original design of the body.

Like most of the others certainly a mud-dwelling species.

While this paper is in process of publication there comes to hand a copy of Dr. JAMES G. NEEDHAM's recent book "A Manual of the Dragonflies of China; a Monographic Study of the Chinese Odonata", Zoologia Sinica, Ser. A. Invertebrates of China, Vol. 11, fasc. 1, 344 + 11 pp., twenty plates, issued by the Fan Memorial Institute of Biology, Peiping, China, October 1930.

Fig. 29. *E. vittigera* RAMBUR, interior view of labium.

This book contains, on pages 108 and 109, a short description of both imago and larva of *Epophthalmia elegans* BRAUER (sub *Azuma* NEEDHAM), the larva being figured on Pl. XI fig. 5 (insect) and 5a (labium).

It may be noted here that the description of the larva, drawn up from a specimen taken near Nanking, does not appear to be very careful, as is the case with numerous other species discussed in this book, the notes on the labium of *elegans* being in fact wholly incomprehensible, and do not apply to *Epophthalmia* at all. The outline-sketch of the larva of this insect is rather caricatural.

ERRATUM.

In the key for the identification of oriental *Protoneurinae,* as given on p. 150 of my previous paper "Contributions to the Dragonfly-Fauna of the Dutch East Indies, II", *Treubia,* 12, 2, Oct. 1930, the following correction should be made:—

The *first* sentences of lines 7 and 9 from the bottom, relative to the position of the nervure *Ac,* should be *transposed.*

G. Abdoelkadir pinx.

EPOPHTHALMIA (Males).

Fig. 1. — *Epophthalmia elegans* Br., *subspec.?* (Formosa); 2. — *E. frontalis* Selys, type („Malaisie"); 3. — *E. vittata sundana* subsp. nov., type (Java); 4. — *E. autralis* Hagen, type (Celebes).

All natural size.

Repr. bedrijf Top. dienst (No. 4873).

CHART OF THE ESTUARY OF THE ROKAN.

I. Central Area. II. Eastern Border Area. III. Western Border Area.
.... Limit of the jeremal area.
--------- Limits of the banks which fall dry at low tide.
oooooooooooo Boundaries of the areas (during the wet and the dry monsoon resp.).

× Jeremal.

THE FISHFAUNA OF THE ROKAN MOUTH.

By

Dr. J. D. F. HARDENBERG

(Laboratorium voor het Onderzoek der Zee, Batavia)

I. PREFACE.

The big centre of fisheries, Bagan Si Api Api, is situated at the mouth of the Rokan-river (Sumatra) in Malacca Strait at about 100° E. and 2° N.

The population is chiefly Chinese, with a few Malayans. Bagan Si Api Api and its sister-settlements Seneboei and Panipahan have about 15000 inhabitants. The fisheries are practised by the Chinese only, the number of the native Malayans engaged in it can be neglected. The fishermen as well as the tradesmen are all immigrants from China. They belong all to the clan of the Hok-Kiens from the neighbourhood of Amoy. As they have their own customs and they speak their own language — indeed one needs the help of an interpreter in order to speak with them, — one may imagine oneself, that a little part of China has been transplanted on the Sumatra-Coast.

Bagan Si Api Api is only about fifty years old now. The first immigrants found here some Malayans fishing with the so-called jeremals (for a description see below). The Chinese soon learned to use them and it is to the jeremal, which therefore is a Malayan and not a Chinese invention, that Bagan Si Api Api owes its wealth. The whole sea in front of the Rokan-mouth is covered now by the jeremals which make the navigation in this region very difficult, the more so as only a few narrow channels between the mudbanks can be used by modern traffic.

Seneboei and Panipahan are younger. They owe their existence to economic circumstances, as the poor fisherfolk left Bagan Si Api Api in order to be independent of the richer merchants. They are mainly engaged now in driftnet fishery. In the course of these fifty years the whole region, with Bagan Si Api Api as a centre, has grown out to one of the most important fishery-areas of the world. The value of all the fishery-products together in 1928 totalled to more than seven millions of guilders. The main-products of the fisheries are fish, shrimps and the so-called trassy (made from Sergestes-species together with young shrimps).

Fish and trassy are consumed for the greater part in the Netherlands-Indies (especially Java and the plantation-area of Sumatra) and shrimps are mostly sold to Singapore.

With a so intensive fishery in a relatively small area one cannot wonder that the question of over-fishing has presented itself and that, in connection with this, it was asked whether a supply of the fish population from outside the area occurs or not. Moreover, numerous difficulties have arisen between the fishermen engaged in the different fishing methods, viz. between the jeremal fishery and the driftnet fishery. The government officials had to act as arbiter in such and similar cases but, of course, did not feel quite competent. A more thourough knowledge of the fisheries and the fishery problems proved desirable. This was the reason of the investigation of which the results are presented here.

For the above purpose I visited Bagan Si Api Api from January 13th to February 13th and again October 2nd—4th, 1929.

II. DESCRIPTION OF THE AREA.

The principal way of fishing is by means of immovable fishtraps, the so-called jeremals. The fished area covers the very wide, estuary-like mouth of the Rokan River. It has its greatest breadth in a north-southerly direction of about 20 sea-miles and its greatest length in an east-westerly direction of about 40 sea-miles. The area extends in a western direction as far as the sister-settlements of Bagan Si Api Api, Panipahan, and in an eastern direction as far as Seneboei, situated on the maincoast opposite the island of the same name (See chart). Along the coast the area extends much farther than Panipahan and reaches into the mouth of the next big river, the Panei and even farther than this. I have however, for practical reasons confined myself to the limits given above.

The very wide estuary-like mouth narrows at a short distance upstream of Bagan Si Api Api.

The island Pulu Pĕrdamaran, is situated in this neck of the river. A bigger island, Pulu Halang Bĕsar (Great Halang) is found near the western shore of the estuary. A rather deep channel (3—4 m at low tide) separates this island from the maincoast. In this channel a strong ebb- and floodcurrent is found. The channel has become much deeper during the last few years. As what is now the maincoast, was about 10 years ago an island, Pulu Halang Kĕtjil (Little Halang). The water between this island and the old maincoast has silted up now. Of course the tide between the two islands became much stronger and a deep channel was formed in which no mud is precipitated. This fact has a great influence on the fisheries here.

A rather deep channel is also found east of Pulu Halang Bĕsar. It contains water even at neap tide.

A third channel is found along the eastern shore, on which Bagan Si Api Api itself is situated.

Between the two last mentioned channels, a great mud-bank is found, which falls dry at low-tide. This bank has a more or less triangular shape, with its top to the Rokan and with its basis to the sea. This bank continues

under water in a north-western direction to the Aroa-islands in Malacca Strait. The depths down to 8—9 m at low tide are indicated by the situation of the fishtraps.

This central bank consist of a liquid mud of such a soft consistency, that as a matter of fact it is not possible to determine the depth with any certainty by sounding. The sounding lead goes down several meters into the soft liquid matter.

In other places the bottom is muddy also, but there the mud is much harder. The banks in the sea near Seneboei and also near Pulu Halang Bĕsar as well as the submarine continuation of the above named central bank are formed by this clayish mud.

In a direction north-west of Pulu Halang Bĕsar along the coast the bottom becomes harder and harder, as the farther away from the island, the more the mud is mixed with sand. Near Panipahan the bottom consists of pure sand.

Close to the coast, which opposite to Pulu Halang Bĕsar consists of a muddish to clayish matter, but near Panipahan of sand, some small mudbanks are found in front of the mouths of a few small rivers.

The eastern shore near Bagan Si Api Api is muddy also and overgrown with mangrove.

In the neighbourhood of Seneboei we find also mangrove vegetation, which causes the shore-line to shift more seaward. North of Seneboei we find first a muddy bottom but more seaward it gradually passes into a sandy one. The latter is situated outside the fished area and is therefore of less interest for our purpose.

The depth is nowhere very great. Between Pulu Halang Bĕsar and Bagan Si Api Api the Central Bank is found and from here the water becomes gradually deeper. A depth of 8—9 m at neaptide is found near the limits of the fished area in a north-west direction.

III. CURRENTS.

We find in Malacca Strait a flood- and ebbcurrent twice a day. It is not surprising, that in this funnel shaped part of the sea, the differences between high- and low-tide are very great. This difference is about 3—4 m and during the springtides, twice a month, it may amount to 5—6 m. In the rainy monsoon, when the river carries down great masses of water, the level of the water may rise much higher, and the whole land be inundated.

An interesting fact is the occurrence of a small freshwater-lake on the island Pulu Pĕrdamaran. I got information that the fauna is a true freshwater fauna. Twice a day the island is surrounded at high tide by brackish water with a salinity of about 8—10‰. The fauna in this water is a fauna, which can also be found downstreams, e.g. near Bagan Si Api Api in jeremal 592. The above mentioned high floods during the rainy monsoon inundate the island and in this way the lake gets freshwater again, together with its fauna. I regret that lack of time prevented me from visiting this interesting island.

Such great differences in the water-level are, of course, accompanied by strong tidal currents. The whole fisheries in this area depend on these tides. Their maximum rapidity has an average of about 3—4 sea-miles an hour and during the spring-time it is much higher.

The direction of the current is of much importance for the fisheries. The jeremals fish with the ebbtide and their long axis must have the same direction as the current. This is an essential condition for the proper working of the jeremals.

The big V-like wings have to catch up the tide and to lead the fishes, contained in it, into the net, which is spread out behind the jeremal (see below).

The flood-current in Malacca Strait goes in a south-eastern direction and the ebb-current opposite to it in a north-western direction, in the long axis of the Strait. At the beginning of the ebbtide the falling water flows in a fanlike way out of the estuary of the Rokan. It flows therefore in a north-western direction along the coast of Panipahan. Along Bagan Si Api Api it flows in a northern direction, which changes into east near Seneboei (see chart). According to this, the direction of the long axis of the jeremals varies between northwest-southeast and west-east.

Now we see, that 5 à 6 sea-miles north of the central bank and north of Pulu Halang Bĕsar the long axis of the jeremals are not directed to the rivermouth, as one would expect, but that the direction has changed into a west-eastern one. At the beginning of the ebbtide the water here also flows out forming a fan, but after some time the main-current in the Malacca Strait interferes with the current out of the Rokan estuary and causes the latter to deviate somewhat in an eastern direction.

The longer the ebbtide flows out, the more strongly this influence of the main-current manifests itself.

The Nautical Guide (Zeemansgids) of the East Indian Archipelago (Vol. II) expresses itself very correctly in saying, that the ebbtide turns against the sun. If we stay some time on one of the outermost jeremals we see, that gradually the current turns more to the east. At the end of the ebbtide the current changes several times in direction and rapidity, obviously as a consequence of the greater or lesser influence of the main current.

The jeremals in this outer area, of course, cannot fish during the whole ebbtide. Some of them even cannot do so for more than 2 à 3 hours only, unlike the inner jeremals (on the central bank), which can continue fishing for 4 à 5 hours. The handicap of the short fishing time of the outermost jeremals is more than amply compensated by the more valuable catches.

Along the coast near Panipahan we do not have such deviations of the currents, neither do we find them along the coast of Bagan Si Api Api or on the central bank. Here the ebb- and floodcurrents are opposite to each other.

As has been said above the ebb-currents are turned in an eastern direction. From this it follows, that it is not the ebbtide but the floodtide in Strait

Malacca, which causes the deviation of the ebb-currents coming from the Rokan estuary.

When the flood comes in, the Rokan estuary is filled up chiefly by currents which come from the north-west and it is only later, when the maincurrent in Malacca Strait gets stronger (N.B. the tide is falling now again in Malacca Strait!), that currents come in from an easterly direction also. It is therefore the ebbcurrent of Strait Malacca in the Rokan estuary which causes these floodcurrents from an eastern direction.

It appears, that the more we go to the west and the farther away from the rivermouth proper, the earlier the flood comes in. Beyond Pulu Halang Běsar near Panipahan high tide is 1 à 1½ hour earlier than near Bagan Si Api Api. The flood already comes in there, when the water is flowing out still between Pulu Halang Běsar and Bagan Si Api Api.

It would be of great importance if this currentsystem could be investigated in a more thorough way by an hydrographer. It would be necessary to investigate not only the direction of the currents and how they interfere with each other, but also, in connection with this, the question of how the masses of water mix. Too little is known about this as yet.

I must also draw attention to a curious phenomenon on the Rokan river, which occurs when the flood comes in. Through the quick rising of the water in the sudden narrowing of the river near Pulu Pěrdamaran, the water is forced up to a tidal wave with an elevation of 1—1.25 m, which moves upstreams with much noise. This fact, known from several other rivers of Sumatra and elsewhere is called here "běno" (Malay).

Although the běno under normal conditions occurs outside our area, viz. on the river proper, I should like to mention it here, as during my stay in Bagan Si Api Api in October 1929 it was observed much farther out at sea on the central bank, at a great distance from Pulu Pěrdamaran.

After a long dry period heavy rains had fallen in the region of the upper course of the Rokan. The level of the river had therefore risen considerably. This takes place every year and great masses of soft material, precipitated in the river during the dry period, are carried off and precipitated again in front of the rivermouth in the sea. Owing to this the central bank is not only made higher, but is also enlarged in a seaward direction over a distance of about three sea-miles.

In the afternoon of October 4th I found myself with a motorboat in the narrow channel along the eastern shore (near Bagan Si Api Api). It was neap tide and the water was so shallow, that even small boats went aground in the mud. The place, where my boat had come aground, was about 9 sea-miles north of Pulu Pěrdamaran. Suddenly a curious streak was seen on the sky-line. The crew thought it was a běno. As a matter of fact about 5 minutes later, I saw a wall of water about 1.25 m high approach. This tidal wave was, at the place where we were, horseshoe-shaped, so that at a given moment the boat was surrounded by the waves on three sides. It was evident, that the somewhat

deeper water of the channel had retarded the rising of the běno by 15 à 20 seconds. The běno was visible as far as I could see. Afterwards I got information, that it had been observed near Pulu Halang Běsar also. From this it seems to follow that the tidal wave had a total breadth of about 8 sea-miles. Where exactly the tidal wave originated I do not know, but I suppose it must have been on the seaside of the central bank. That is, therefore, 17—18 sea-miles outside the place where it normally arises, near Pulu Pĕrdamaran. It was two days after full moon and therefore in the period of the very high tides. The phenomenon had never been observed before at that place by the skipper of the boat, who had lived ten years already at Bagan Si Api Api. It did not occur again.

The seaward extension of the central bank takes place every year, when after a long dry period, the first rains have come. The extension is afterwards carried away again little by little by the currents so that the central bank finally retains about the same shape.

IV. SALINITY AND COMPOSITION OF THE WATER.

It is evident, that in an area as described above, the salinity may vary very much locally, according to the tides and to the amount of the freshwater carried off by the river. As was said above our knowledge of the salinities is, as yet, very incomplete and closer investigation would be very useful.

At the outermost limits of the fished area the salinity is high and relatively constant. Salinities of 28—31$^0/_{00}$ were found. Once I found at low tide even a higher percentage than at hightide! At jeremal 844 the salinity was 28.98$^0/_{00}$ at low and 28.82$^0/_{00}$ at high tide. Evidently we have had here water of Strait Malacca, only slightly mixed with fresh water.

Near the coast of Panipahan I found similar relatively high salinities.

The fresh water seems to have little influence here. This is to be expected, as only a small quantity of water flows out of the rivermouth along the coast in the direction of Panipahan, as has been pointed out above. Most of the Rokan water is carried off in an eastern direction by the currents in the Straits of Malacca.

In the sea near Seneboei therefore we may find lower salinities and as a fact I found 2½ hours after high tide a salinity of 22.72$^0/_{00}$. Lower figures can be expected at low tide. At high tide I found there a salinity of 28.75$^0/_{00}$.

Near jeremal 180 I found a salinity of 19.29$^0/_{00}$ and near jeremal 602, 17.60$^0/_{00}$. In each of the two cases it was three hours after low tide.

On the roadstead of Bagan Si Api Api, I found very varying figures viz. 6.33—17.14$^0/_{00}$ at low tide and 11.80$^0/_{00}$—21.60$^0/_{00}$ at high tide. The lowest figures were found at neaptides (6.33—11.80$^0/_{00}$) the highest at springtides (17.14—21.60$^0/_{00}$).

Dr. Ir. C. P. MOM, Head of the Proefstation voor Waterzuivering, kindly analyzed for me a sample of water taken 3 sea-miles north of Bagan Si Api Api. It had a salinity of about 15$^0/_{00}$. All figures are given in mgr pro liter.

Dry residue	17600,0	Mg.	579,7
Clowing residue	14600,0	Fe.	0,48
Organic matter	27,2	Mn.	absent
NH_3	a trace	HCO_3	73,2
Prot. NH_3	absent	SO_4	1179,8
NO_2	a trace	Cl	8450,0
NO_3	0,5	Si O_2	325,0
Ca.	281,2		

From the above data it follows, that we have here brackish water with a great amount of mud. In the eastern part of the area the muddiness of the water is much greater, than in the western part. Near Bagan Si Api Api the muddiness is sometimes so great, that we can speak of liquid mud. The degree of clearness is zero here. Near Panipahan the water is muddy at low tide only. Near Seneboei and also in the area north of the central bank we find relatively clear water at high tide, which becomes very muddy at low tide. The water between Pulu Halang Bĕsar and the maincoast is also very muddy. It is evident that the degree of muddiness has great influence upon the composition of the fauna.

Further the above figures show that the water is very poor in Ca. Perhaps this is the reason of the poverty of the mollusc fauna, of which I found only two representatives.

The Fe percentage is very great, as is the case with the Si O_2 percentage, whereas the percentage of SO_4 is small only.

It seems evident that these deviations from the composition of normal seawater found their origin in the freshwater from the Rokan.

V. GENERAL REVIEW OF THE FAUNA (FISHES EXCEPTED).

The waters near Bagan Si Api Api are very rich in plancton, but as a consequence of the quantities of mud, it is often almost impossible to make an analysis of it. Obviously even the most muddy water contains many organisms as may be seen from its phosphorescence. The latter is caused mainly by *Noctiluca.*

It is obvious, that an area as described above, will contain a very special higher fauna. Before I deal with the fishes, whose study was the main-purpose of my visit to Bagan Si Api Api, I will give a short summary of the other animals characteristic of this region.

I will begin by mentioning a few birds, which may be observed along the shores.

Along the muddy coast the Indian Marabu (*Leptoptilus javanicus* HORSF.) and the Indian Tantalus (*Pseudotantalus cinereus* HORSF.) can be seen everywhere, sometimes in mixed flocks of about 10 à 20 individuals. *Pseudotantalus* has the curious habit of trampling with its feet in the mud in order to start up the food animals.

During the wintermonths October-March one can see thousands of limicoline birds of different species along those parts of the coast, which are dry at low tide.

They are mostly found on the shores near Seneboei and near Pulu Halang Bĕsar where the bottom is composed of a somewhat harder mud. In places where the mud is soft they are absent altogether.

In the mangrove swamps along the coast one meets regularly little bands of monkeys e.g. *Macaca irus* CUV. and *Pithecus pyrrhus* HORSF. *Macaca*, the common monjet or kra, can often be seen searching for food on the ground on dry parts of the shores. I never saw *Pithecus* do so. In the evening they are to be found in some special trees.

After it has becomes quite dark thousands of fire-flies (*Colophotia brevis* ERN. ? det. LIEFTINCK) appear. They seem to prefer a special species of mangrovetree (*Avicennia*). It is a beautiful sight, when whole stretches of shore glitter and darken rhythmically.

This rhythm maintains until about 11—12 p.m. Afterwards it gets more irregular and after about 3 a.m. only a sporadic flash of a single individual is seen.

Along the whole coast crocodiles (*Crocodilus porosus* SCHNEIDER) are fairly common. Many accidents are caused by these animals. When cruising along the shore, one can often see big specimens starting up and dashing into the water. Once I saw about 20 à 30 animals watching for fish in very shallow water. Every now and then a kind of mullet jumped out of the water, for a reason unknown to me. They were snapped up in the air by a swift jerk of the head.

Everywhere one sees on the mud big specimens of *Periophthalmus chrysospylos* BLKR. They are sometimes caught by the swift current, so that it is not possible for them to reach land again. In that case they seem to drown. At least I found a few times in a certain catch from a jeremal near the coast a dead and stiff specimen, which therefore had died some time before already and had come dead into the net.

Species of *Boleophthalmus* are much less common.

I found only two species of Molluscs, viz. *Arca granosa* L. and *Elisia orbiculata* WOOD. (Det. VAN BENTHEM JUTTING). The latter seems to prefer brackish water. Both species are eaten.

Shore crabs are only sporadically seen. I suppose that the great differences between low and high tide are fatal to all species with a more or less terrestrial habit.

Let us now consider the animals found farther from the shores.

In the water near the shore the big mangrove-crab, *Scylla serrata* FORSK. (Mal. Kĕpiting) is often caught. This species lives especially upstream off Bagan Si Api Api, where the water is chiefly brackish, but it is found elsewhere in the mangrove-swamps also. Farther out in the sea, we find another Decapod, a little swimming-crab, *Charybdella rostrata* MILNE EDWARDS. It is

one of the characteristic animals of the Eastern Border Area. (See below. See chart). It is found regularly in each catch, but never in great numbers.

I found only these two Decapoda brachyura.

In the Eastern Border Area two big Stomatopods are taken regularly, viz. *Squilla raphidea* FABRICIUS and *Squilla interupta* WOOD MASON. I did not find them outside this region.

Shrimp species are found everywhere in the fished area. They are most common in the Eastern Border Area and less common in the Central- and Western Border Area.

The Shrimp-fauna is composed of several species, among which *Penaeopsis*- and *Parapenaeopsis* species are the most common. *Penaeopsis affinis* M. E., *Penaeopsis brevicornis* M. E., *Parapenaeopsis gracillima* NOBILI and *Parapenaeopsis sculptilis* HELLER are the representatives of two genera. Besides these *Alpheus euphrosyne* DE MAN, *Exhippolysmata ensirostris* KEMP and *Mimocaris heterocarpoides* NOBILI are found sporadically. Prof. Dr. H. BALSS was so kind as to determine these species for me. Perhaps more species will be found when thoroughly analyzing a great number of catches, but the species mentioned above are any rate the most important.

Sergestes species are very important from a biological and economical standpoint. They are caught in large quantities on the central bank and in some parts of the Eastern Border Area, especially in the parts situated near the Central Area. Elsewhere in the fished area they are not so common and they are not caught in commercial quantities. Examination of the contents of the stomach shows that *Sergestes* is a very important fish-food.

Sea-snakes are found abundantly everywhere.

They are never or seldom seen, but they are regularly caught by the jeremals. They are especially abundant, where the water is very muddy, as is the case on the central bank. Farther seaward where the water gets clearer they are less common. Curiously enough they are caught very abundantly between Pulu Halang Běsar and the coast. A jeremal may catch there about six or seven snakes in a quarter of an hour. I do not know why they prefer this special region.

Unfortunately I have not collected these animals systematically. Determination at the Laboratory showed that the material contained one species only, viz. *Hydrophis torquatus* GÜNTHER. Other species, which eventually may be found, are at any rate not common.

NELLY DE ROOY in "Reptiles of the Indo Australian Archipelago" mentions for Bagan Si Api Api, besides the species named above, also *Enhydrina valakadyn* BOIE.

On the surface of the water *Halobates* is sometimes rather abundant. Where the water is muddy and opaque they are absent, at least I did not see them in that case. Their occurrence, therefore, is confined to the Western Border Area and to the western part of the Eastern Border Area.

This richly developed animal life attracts of course many birds.

Thus one may see on the dry shoals and on the jeremal themselves, sometimes even far out at sea, a number of white herons, an *Aigretta*- or *Demiaigretta*-species. They are especially abundant near Seneboei and Pulu Halang Běsar. They are often seen together with a *Sterna*-species.

The common *Haliastur indus* BODD. can be observed everywhere in our area along the coast. In the neighbourhood of Bagan Si Api Api this species is surpassed in numbers by the osprey, *Cuncuma leucogaster* GM. Often one sees no less than 15 à 20 of these big birds together and everywhere in the neighbourhood of the town one discovers their nests in the higher trees.

Their food consists partly of snakes. Several times I found snakes which had been partly eaten and I also saw a few times an osprey grasping a snake out of the water and carrying it towards the land.

As soon as we are somewhat farther away from the coast frigatebirds (*Fregata ariel* GRAY) can be observed regularly.

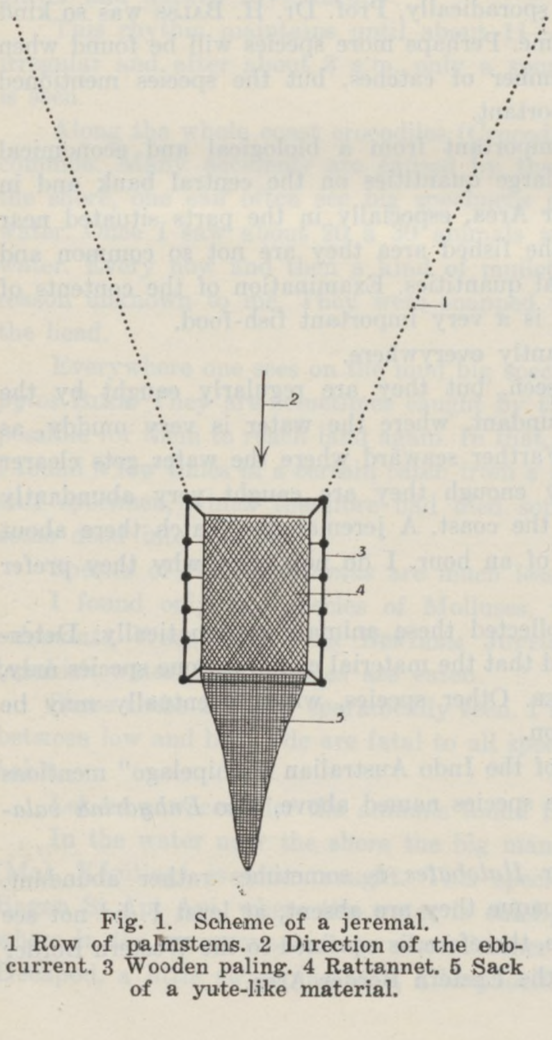

Fig. 1. Scheme of a jeremal.
1 Row of palmstems. 2 Direction of the ebb-current. 3 Wooden paling. 4 Rattannet. 5 Sack of a yute-like material.

VI. METHODS OF FISHING.

In studying the fishfauna I had to make use of analyses of the catches of the different jeremals. A jeremal is composed of two rows of palmstems, which have been driven into the bottom and which are placed in the shape of a big V. The median axis of this V, of which the two wings may have a length of five hundred meter, is placed in the main direction of the ebbtide. The wings of the V converge to a rectangular, wooden paling, in which a fine-mazed net of rattan has been suspended. (See Fig. 1).

This flat rattan net forms an inclined plane. The end turned to the opening of the V rests on the bottom, the other end lies just below the surface of the water. Behind this rattan net is placed a sack, made of rough cloth (something like jute). The fishes which through the force of the current are driven over the back-

edge of the rattan net are caught in this sack. From time to time (about every 20—30 minutes and sometimes even shorter) the sack is hauled up and is emptied. The palmstems, which are placed at distances of about half a meter, are moved to and fro by the strong current. The fishes, which happen to come inside the wings of the V, are frightened by these wobbling stems.

They swim back to the middle of the V again and again, and are driven finally against the net and everything driven against it is caught. Only big fishes, which are strong swimmers may escape sometimes. They may jump over the net or they may swim or jump back against the current.

In general the fisherfolk think that the jeremal will catch anything, that has come between the wings of the V. Yet I doubt if this opinion is quite right.

In the first place the above-mentioned big fishes, once escaped, are not caught again in the sack. They have to swim therefore round one of the wings of the V or they have escaped between the wobbling stems.

In the second place it is possible to catch fish with the hook, behind the palmstems. If the wobbling row of the stems should hold up every living fish, one would expect just behind this row a region practically devoid of them.

In the third place I draw attention to the following curious information, which I got from the fishermen. At the beginning and at the end of a catching period, the same species are caught. Thus at the beginning and at the end of the ebbtide, when the current has not yet reached its full strength and when the strength of the current decreases again. Species are caught then, which in the middle of the catching period, when the current is very strong, are caught in small numbers only or are absent totally.

Although the phenomenom was not very marked, I found some facts, which showed me that the fishermen were not entirely wrong. To verify this, it would be necessary to visit several jeremals and stay there for the whole catching period of 4—5 hours in order to examine carefully the succeeding hauls.

And this should be repeated several times for the same jeremal.

Lack of time prevented me to do this in the same way mentioned above, but I can give here a catch record of jeremal 592, taken on January 18th, 1929.

(This catch record and all others are a recapitulation only of my notes, as I made them on the jeremal during the fishing period. An exact analysis was made only later on at the laboratory. Rare species are therefore often not mentioned in this record, as they are not of interest for the composition of the catches).

Catchrecord of jeremal 592.

8 h. 30 m. About neap tide.

9 h. First haul. It consists chiefly of *Eleutheronema tetradactylum, Harpodon nehereus, Gobioides anguillaris* and *Gobioides cirratus* and many shrimps (*Penaeopsis* and *Parapenaeopsis*). Some young fry.

9 h. 35 m. About the same composition.

Harpodon and shrimps are caught in much smaller quantities.

10. h. 15 m. About the same composition. *Harpodon* and shrimps have nearly disappeared.

10. 40 m. A very big catch. It consists chiefly of *Gobioides*. Further the composition is about the same as before. A few big specimens of *Arius maculatus* and many small ones. A few *Stolephorus baganensis*.

11 h.. About the same composition. A few specimens of *Pangasius polyuranodon* and *Pangasius nasutus*. A small number of *Cryptopterus hexapterus*. A few small specimens of a *Trichiurus* spec. A few *Cyprinids*. *Gobioides* is much less common now.

11 h. 35 m. About the same composition, but which a large quantity of shrimps and *Harpodon*. The strength of the current has much decreased.

Two catches were hauled in after this. The composition remained wholly the same.

From the above data it follows, that at any rate *Harpodon* and also the shrimps are most common at the beginning and at the end of a catching period.

Of course there must be a reason for this. Now it is well known that *Harpodon* as well as shrimps are poor swimmers. *Harpodon* swims clumsily and slowly. The shrimps swim better, but they are by no means long-distant swimmers. I suppose, that this slow swimming is the cause of the curious fact, that these animals are not caught during a strong current. At first sight this seems very paradoxical. When the current is slow, *Harpodon* is scared back by the wobbling palm-stems and may swim back to the middle of the V. In doing so again and again they come at last against the net, which is the fundamental principle of this method of fishing. When the current is strong, *Harpodon* is simply carried away by it and in this case the fishes are dragged through the openings of the row of palm-stems.

It is possible that these slow swimmers bury themselves in the mud when the current is too strong. Yet I hardly believe that this can be the case. Considering the catchrecord of jeremal 521 one is lead to conclude that *Harpodon* is very sensible to the strength of the current, as every time the latter becomes stronger, *Harpodon* disappears out of the catches, to come back again the moment the strength of the current lessens.

Catchrecord of jeremal 521 January 24th, 1929.

I cannot give the whole catchrecord, as I went away at sunset before the end of the catching-period. Jeremal 521 is interesting through the fact that during the fishing the strength of the current changed several times. See also page 84.

4 h. 40 m. The net is lowered.

5 h. The first catch. It consists chiefly of *Harpodon*. Furthermore a few specimens of *Pellona, Trichiurus, Stolephorus baganensis, Dorosoma chacunda* and *Setipinna taty* are found.

5 h. 30 m. The current, which at first became stronger and stronger, now lessens.

In the catch, which is hauled in now at my request, *Harpodon* is rare.

The catch consists chiefly of *Caranx rottleri, Eleutheronema tetradactylum, Stromateus cinereus* and also some *Pellona, Dorosoma chacunda, Trichiurus, Trygon, Stolephorus, Trypauchen* and *Engraulis kammalensis.*

5 h. 50 m. The strength of the current begins to increase again. Thus the catch of the last twenty minutes is taken during a slow current. *Harpodon* is abundant now! For the rest the composition of the catch remained about the same. *Sergestes* is also abundant now.

6 h. 15 m. During the last twenty-five minutes the current was strong. In this catch *Harpodon* is very rare again! The components of the catch are the same as those of the last one. Some young specimens of *Cybium kühlii* are found. Also *Sergestes.*

6 h. 30 m. The current keeps the same strength. *Sergestes* is rather abundant now. The catch consists of the same components. Only *Eleutheronema* is found in greater abundance than in the former catches.

We see in this case that *Harpodon* is found in greater or smaller quantities, depending on the lessening or strengthening of the current. At the same time the other components of the catches remain about the same. (The abundance of *Eleutheronema* in the last catch is caused by other circumstances. See page 123).

If the first explanation of the curious behaviour of *Harpodon* (viz. that *Harpodon* is dragged through the row of stems, when the current is strong and not, when the current is slower) be right, then it has to be explained also, why strong swimmers are caught especially when the current is strong. This can be explained by assuming, that these swift swimmers can escape the net when the current is still slow and in this case they may escape through the row of stems.

The supposition that the fish may escape through the row of palmstems under certain conditions, is supported also by a look of the catches made by the so-called si-tsji-net. A si-tsji is a bag-shaped net with two fine-mazed wings in the shape of a V. The median axis is placed in the direction of the current, just as is the case with a jeremal.

In fact we have here a net, which catches in precisely the same manner as the jeremal, but with wings not consisting of a row of palmstems. The advantage of this over the jeremal is, that it is transportable, although when in use, it is of course, fixed to the bottom by stakes.

Several of these nets are placed in a row side by side and each net has a length of 16 m. between the ends of the wings. Together they catch much more than would be caught by a jeremal with the same width between the ends of its wings. Each net is therefore rather small, as otherwise the mass of the catch would be too heavy and the net be torn up. These big catches are of course a consequence of the fact, that the wings do not allow anything of importance to escape. If the wings of the jeremal could also prevent, that a part of the catch escaped, there would be no difference in the catches. A few of these nets are used near Pulu Halang Běsar and in the Strait between the island Sene-

boei and the coast. At other places their use has been forbidden now, as they are considered to do too much harm to the fishfauna.

I have tried to prove experimentally, that fish can escape between the stems. To this end I used a small net, which had about the same model as the above-named si-tsji. The catch of half an hour consisted of some *Sergestes* and shrimps together with young fry of several fish species. One mature specimen of *Setipinna taty* was caught also. This very small catch is caused by the small dimensions of the net, which had a total breadth of 2 m, and a height of 1 m. only. A net of greater dimensions than those of the commercial ones, would no doubt have caught much more. But at any rate this small catch showed that some fish may escape between the stems and the jeremal therefore does not catch everything.

Information, which I got from R. M. Pratomo, physician at Bagan Si Api Api, shows also that the row of stems allows fish to escape and that only certain species of fish may go through the openings. Behind the wings of a jeremal a so-called ambei or bubu was placed. (An ambei is a small net of about the same shape as a si-tsji. It has very fine meshes and it is used for catching shrimps or Sergestes [depending on the size of the meshes]. These nets are used chiefly on the central bank and near Pulu Halang Bĕsar. Of course they may catch an occasional fish also. In this bubu *Eleutheronema tetradactylum* was chiefly caught and in the jeremal itself the catch consisted mainly of *Stromateus cinereus*. If the row of stems did not allow anything to escape, then the bubu would have remained empty of course.

Returning to *Harpodon nehereus*, if this species could behave in the same way as *Eleutheronema tetradactylum* when the current is strong, it would not be necessary to assume, that it has buried itself in the mud, when it is absent in the catches, as we have suggested above.

From the facts given above we see that a jeremal may catch indiscriminately species of fish present in a given area. Jeremalcatches give therefore a very complete insight into the composition of the fishfauna, unlike most other fishnets, which have a more selective action. Quantitatively we can use the catches with some reserve only. The greater or lesser abundance of a given species in the catches depends on certain circumstances also. If a species is rare in a catch, it is not necessary to conclude, that this species is really rare also in the area of that jeremal. Nevertheless this is mostly the case, as there is always a moment when the strength of the current is favourable for the catch of that special species and at that moment we can see whether it is really rare or not.

The jeremalcatch gives a rather good record of the different stages of length of a species in a given area.

The fine meshes of the net do not allow even the young fry to escape and only very big individuals can evade it.

Besides the methods of fishing mentioned above driftnets and lines are also used.

Driftnet fishery is chiefly found outside the jeremalarea (outside the dotted line on the chart). Only big fishes are caught in this way. Hook and line are used all over the estuary. Of course only predatory fishes are caught.

The following are the main species taken by the driftnets:

1. *Chirocentrus hypselosoma.*
2. *Pellona* spec.
3. *Eleutheronema tetradactylum* (The mature specimens).
4. *Polynemus indicus* (This species is commonly caught).
5. *Sphyraena* spec.
6. *Pristipoma guoraca* (Very common)
7. *Proteracanthus sarissophorus.*
8. *Sciaena* spec. (The big specimens).
9. *Sciaenoides microdon* and *brunneus* (Big and mature specimens).
10. *Megalaspis cordyla.* (Not observed by myself).
11. *Scomberoides lysan.*
12. *Cybium kühlii* (Rare).
13. Several species of sharks.

VII. REGIONAL VARIATIONS IN THE CATCHES.

In examining the jeremal catches of various regions we see, that the composition may be quite different. These differences remain practically constant on succeeding days, and only small fluctuations are to be found. During the different seasons the catches remain constant also (a few cases excepted! See below). A comparison of the catchrecords of January and of October shows sometimes so little difference, that they might have been copied from each other.

As an example I give the list of the species caught in jeremal 790 on January 13th and October 3rd, 1929.

	13 January.	3 October.
Septipinna taty	Abundant. Mature.	Abundant. Mature.
Coilia dussumieri	Abundant. Mature.	Abundant. Mature.
Raconda russelliana	Rare, Mature and immature.	Rather rare. Mature and immature.
Kurtus indicus	Rare. Mature.	Rare. Mature.
Harpodon nehereus	———	Rare. Mature.
Sciaena spec. (sp. *Sc. glauca*)	Rare, Mature and immature.	Rare. Mature and immature.
Trichiurus spec.	A few.	A few.
Dussumieria hasselti	———	A few.
Pellona amblyuropterus.	A few.	A few.
Megalaspis cordyla.	A few. Juvenile.	A few. Juvenile.
Stromateus cinereus	A few Immature.	Rare. Immature.
Clupea macrura	———	A few. Immature.
Clupea toli	A few. Immature.	———

Hemirhamphus marginatus.	A few.	A few.
Tylosurus strongylurus.	A few.	A few.
Stolephorus baganensis.	Rare.	Rare.
Muraenesox talabon	———	A few.
Chirocentrus hypselosoma.	A few.	A few.
Carcharias mülleri	A few. Juvenile.	A few. Juvenile.
Cybium kühlii	———	A few. Juvenile.
Setipinna breviceps.	A few.	Rare.
Eleutheronema tetradactylum.	A few.	A few.
Dorosoma chacunda.	A few.	A few.
Stolephorus tri.	A few.	———
Engraulis dussumieri.	A few.	———
Pellona ditchoa	A few.	———
Tetrodon lunaris	A few.	———
Cynoglossus lingua	A few.	———
Gobioides gracilis	A few.	———

All the species named above were to be found in one single catch. It may be seen at a glance, that the most important factors are the same in January as in October and they are found in the same quantitative proportions. The less common species are of course not always to be found in each of the two catches, but this is to be expected from such occasional guests. It is possible that some of the species, which were absent in October would have been found when a more thorough examination was made. In October I examined the catch only superficially and therefore it may be, that some rare species escaped my notice. In January I stayed on the jeremal during the whole catch-period and I had therefore opportunity to find rare species.

When I went to Bagan Si Api Api for the second time in October, I intended comparing the catches of the dry with those of the rainy monsoon.

I regret to say, that this was not possible as a fortnight before I arrived in October, heavy rains had fallen and large quantities of freshwater were coming down the river, just as was the case in January. I cannot say therefore, if there is a difference in the fauna during the dry and the rainy season.

A difference in the composition may be expected as the Rokan river carries off less water in the dry than in the rainy season and the water in the estuary will therefore have a higher salinity. I got information, that some species of fish are found more to the coastward or more to the seaward in the different seasons, according to the difference in the salinity. As I pointed out above, I cannot give any data from my own experience. (Yet I found similar facts in the rivermouths of Borneo).

In analysing the catches of more than eighty jeremals, spread all over the estuary, I concluded that in the fished part of the sea three areas may be distinguished.

I will call these areas:

1. **The Central Area.**
2. **The Western Border Area.**
3. **The Eastern Border Area.**

Besides the more or less gradual differences in the salinity of the water in a rivermouth, the consistency of the bottom also has a certain influence on the composition of the fauna. The bottom may consists of soft or somewhat harder mud or of sand.

The three areas named above coincide with the areas of different bottom-deposits.

The Central Area includes the central bank and its nearest environment. The bottom consists of soft mud. The water is during the ebb- and flood-tide very muddy.

This area has a special mudfauna of its own. Besides the freshwater species, sometimes descending into the brackish water of the estuary, also saltwater-species are found here, which have come from more seaward parts. Specimens of the first group are mostly found, of course in that part of the area nearest the rivermouth. Specimens of the second group are mostly found in the outer part of the Central Area.

In the Central Area one can also find the fry and young specimens of species, which live in the border area or even farther out in the sea when adult. Many species migrate towards the coast when they are young.

The Eastern Border Area is situated outside the central bank. The bottom consists of a hard mud in all gradations down to the soft mud of the central bank and to sand. The water in this area is very muddy during the ebbtide only and during the floodtide it shows all degrees from opaque to clear.

This area consists of the whole jeremal-area from Seneboei to the coast opposite Pulu Halang Běsar which is partly or wholly included in it according to the season. (See below page 154). Further it is limited by the Central Area and by the seaward limit of the fished area. Actually this region is nothing but a submarine continuation of the central bank.

A special fauna is found here too.

This fauna is mixed with inhabitants of the central bank on the one side and with inhabitants of the open sea on the other side. The latter are represented partly by young specimens only. In the western part of this area species, characteristic of the Western Border Area are also caught now and then.

The Western Border Area is situated along the coast in front of Panipahan. It is the smallest and the least important one. The bottom consists of pure sand and the water is much clearer than in the two other areas.

It is obvious from what we have seen above that each of these three areas has its own characteristic species or groups of species.

It is even posible when examining a given jeremalcatch, to say where the jeremal is situated.

The boundaries are of course not very sharply defined and one area passes

into another more or less gradually. In the first place the limits move with the ebb- and floodtide. A jeremal just on the boundary between two areas will catch other species of fish at the beginning than at the end of the ebbtide. And in the second place species characteristic of one area may go astray into the other.

A closer examination of the catches shows that slight differences exist within the areas themselves. These differences however are so small, that it does not seem advisable to split up the areas into several smaller ones.

Of course the fishermen themselves know these differences very well and each region has its own name. Along the coast the parts of the sea are always called by the name of the settlements or of the rivulets emptying into the sea. Thus they speak of the jeremals of Bagan Si Api Api, of Seneboei, or of Soengei Si Andam, etc.

The sea north of the central bank, down to a depth of 2 m at low tide, is called Pak Tau [1]). North of this is situated the Sai Pak Sai. North-east of Pulu Halang Běsar the region is called Pah Tang and north of the island the sea is called Pah Tang Sai.

For the sake of convenience I have divided the chart of the estuary into the sections I—VI and each of the latter subdivided into the parts A—J.

VIII. FISHFAUNA.

The fishfauna is by far the most important and every year quantities to the value of millions of money is taken out of the sea.

It is a well-known fact that the fishfauna near the coast and in the neighbourhood of rivermouths is richer than elsewhere in the sea. This is in a high degree the case in the mouth of the Rokan. It is no doubt a consequence of the abundance of food in the water, which is greater than that in most other rivermouths. The accumulation of individuals relates only to a number of definite species, viz. only such species as are adapted to the conditions of life offered by a rivermouth.

The area in front of the Rokan river is very rich in individuals, but the number of species is for a tropical region relatively limited. I counted all in all 149 species, all occasional guests included. This number includes 13 species, which I did not see my self, but which are mentioned by WEBER and DE BEAUFORT in their "Fishes of the Indo-Australian Archipelago" and also two species found by Prof. DELSMAN in a collection made by Mr. DE WAART in 1922.

This total number of 149 species may increase without any doubt by the addition of several more or less occasional guests, but I do not think there will be many of them.

Of these 149 species 80 only are to be found regularly and of these eighty

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1) Sai = West. Pak = North. Tang = East. Tau = Centre. A look at the chart will explain different names.

species fifty or sixty only are common. Seventy species, the lesser half therefore, are more or less occasional guests.

We may expect, that an area, where the salinity is liable to change so much and where all degrees are found from liquid mud to clear water, will have its own special fauna. This fauna is to be found again modified more or less by the local circumstances, in all big rivermouths of Sumatra.

I will give of each fish a full account of the places, where I got it. Each jeremal has a licence, which is numbered. I used the number [1]) of these licences in indicating the jeremals. As I did not visit all the jeremals the numbering shows big gaps.

When dealing with a certain species I give first the regions in which it is found. Below each region I put down the numbers of the jeremals, situated in it, where the species has been caught.

Behind each number I indicate the abundance. (Very abundant, rather abundant, rather rare, rare, very rare). I give further behind each number the stage of maturity of the fish, as far as it has been determined.

I use the scientific names and the system followed by Weber and de Beaufort in their "Fishes of the Indo-Australian Archipelago", as far as it has been published. For the families not treated by the above named authors I follow Day's "Fishes in India". Only for the Carangidae I use the generic- and specific names as given by Wakiya in his "The Carangoid Fishes of Japan" (Annals of the Carnegie Museum. Vol. XV 1924).

Fam. *Elopsidae.*

1. **Megalops cyprinoides** (Brouss.).

I only saw a few specimens of this species at the fishmarket of Bagan Si Api Api. I could not get any information as to the exact place where these fishes had been caught. At any rate they are not abundant at all in the sea near Bagan Si Api Api.

Fam. *Clupeidae.*

2. **Chirocentrus hypselosoma** Blkr. (See Delsman, Hardenberg in Treubia Vol. XII 1930).

I D	I E	I F	II B
781 A few.	515 A few.	753 1 specimen.	778 A few.
	844 A few.		

II D	II E	II F	II G	II H
173 A few.	117 1 specimen.	567 1 specimen.	790 A few.	248 A few.
315 1 specimen.		776 A few.		251 1 specimen.
259 1 specimen.				
780 1 specimen.				

II I	III C	III D	III E
774 1 specimen.	84 A few.	68 A single.	218 1 specimen.

[1]) Of the jeremals x_1, x_2, x_3 I do not know the numbers.

Chirocentrus is a fish not living in shoals and is never caught in big numbers. In January I only saw fishes of about 40 cm up to a length of about 80—90 cm, they were all mature. In October I found, side by side with fishes of the same length as given above, rather abundantly also young fishes of about 10—20 cm, which seemed to be lacking totally in January.

I can not give an opinion as to the meaning of this fact. It is evident from the chart, that *Chirocentrus* frequents that part of the sea, which is situated north of a line passing from Soengei Siandam north of Pulu Halang Bĕsar and the central bank to Seneboei. In the very muddy water south of this line Chirocentrus evidently does not occur.

This species is mature at a length of about 40 cm.

3. **Dussumieria hasseltii** BLKR.

I F	II B	II D	II G	III C
753 A few.	778 A few.	780 1 specimen.	686 1 specimen.	546 A few.
			790 1 specimen.	

This species too prefers relatively clear water. It is very rare, a single specimen only was found in the catches from the jeremals 686, 790 and 780. They are most probably all strayed specimens as *Dussumieria* lives in small shoals. In the jeremals in front of the mouth of the Panei river where the water is not so muddy as in front of the Rokan, they are therefore rather abundant.

For the fisheries of Bagan Si Api Api this species is of absolutely no importance. I found it in January as well as in October.

4. **Dorosoma chacunda** (H.B.).

I H	II B	II D
845 A few.	778 A few. Mature.	173 A few. Mature.
		315 Rare. Mature.
		780 A few.

II G	II H
686 A few. Mature.	809 A few.
790 A few. Mature.	248 Rare. Mature and immature.
658 1 specimen. Mature.	521 Rather abundant. Mature and immature.

II I	III E	III F
774 A few.	218 A few. Mature.	171 A few. Mature.
		559 A few.

III G	III I
652 One specimen. Mature.	421 A few. Mature and immature.
562 A few. Mature.	
X_1 A few.	

IV D	IV F
676 A few.	72 A few.

Dorosoma chacunda is found in the whole area and is as a matter of fact missing only in the part of the sea between Poeloe Halang Besar and the maincoast of Bagan Si Api Api. It seems that this species avoids the very muddy regions. As a fact *Dorosoma chacunda* prefers the shallow water along the coasts and is to be found regularly in front of other rivermouths also.

This species is ripe at a length of about 15 cm.

5. **Setipinna melanochir** (BLKR.).

This species is mentioned by WEBER and DE BEAUFORT in their "Fishes of the Indo-Australian Archipelago" for Bagan Si Api Api. I could not get this fish myself.

Most probably they live above Bagan Si Api Api in the river proper. Of the three *Setipinna*'s occurring in the Archipelago this species is the one which is most often found in fresh water, as I could ascertain in other rivers.

6. **Setipinna breviceps** (CANTOR).

I. E.
515 A few. Immature.

I. H.
845 A few. Mature.

II. D.
173 A few.
315 A few. Mature.

II. E.
117 1 specimen.

II. F.
567 A few. Immature.
776 Rare. Mature and immature.

II. G.
658 A few. Mature and immature.
686 A few. Immature.
790 Rare. Immature.

II. H.
809 A few. Mature.
248 Rare. Mostly immature.
521 Rather abundant. Mature and immature.

II. I.
774 A few. Mature and immature.

III. C.
86 A few. Mature and immature.
84 A few. Mature and immature.

III. D.
68 A few. Immature.
69 Abundant. Mature and immature.

III. E.
218 Rare. Mostly immature.
571 A few. Juvenile.

III. F.
171 A few. Mature and immature.
559 A few. Immature.

III. G.
652 A few. Immature.
562 A few.

IV. D.
676 A few. Immature

X_2 A few.
602 Fry. Rather abundant,

IV. F.
104 Abundant. Immature.
310 A few. Immature.
Boeboes before Halang. A few. Immature.

IV. E.
520 A few.

IV. G.
195 Fry. Rather abundant.

V. E.
470 1 specimen. Immature.

This highly esteemed food fish is mostly caught in a few specimens only, and seems to avoid the waters with very muddy bottom near Bagan Si Api Api and the waters with sandy bottom near Panipahan. Most specimens caught are immature and in some jeremals even young fry is found rather abundantly. (Nr. 602 and 195). *Setipinna breviceps* thus propagates in the fished area in front of Bagan Si Api Api. WEBER and DE BEAUFORT also mention *Setipinna breviceps* for this place.

The species is mature at a length of ± 25 cm.

7. **Setipinna taty** (C. V.).

I. D.
781 A few. Mature.

I. E.
515 Rare. Immature.
844. Rare. Mature.

F.
753. Rather abundant. Mature.

I. H.
845 Abundant. Mature.

II. B.
X_3 A few.

II. D.
173 Rare. Mature.
315 Abundant. Mostly mature.
259 Rather abundant. Mature.
780 Abundant. Mature and immature.

II. E.
117 Abundant. Mostly mature.

II. F.
567. Abundant. Mature.
776. Abundant. Mature

II. G.
658 Abundant. Mature.
686 Rather rare. Mature and immature.
790 Very abundant. Mostly mature.

II. H.
809 Abundant. Mature.
404 Abundant. Mature.
248 Abundant. Mostly mature.
521 Rather abundant. Mature, and also some fry.

II. I.
774 Abundant. Mature.

III. C.
546 A few. Mature.
86 Abundant. Mostly immature.
84 A few.

III. D.
68 Abundant. Mature.

III. E.
787 Abundant. Mature.
218 Abundant. Mature and immature.
571 Rather rare. Mature.

III. F.
171 A few. Mature.
103 A few.
559 A few. Mature and immature.
901 A few.
104 Rare. Immature.

III. G.
652 Rather abundant. Immature.
562 Abundant. Mature.
X_1 A few.
602 A few. Immature and some young fry.

III. I.
421 A few. Immature.

IV. D.
X2 Abundant. Mature.
676 Abundant. Mostly immature.

IV. E.
520 Rather abundant. Mature and immature.

IV. F.
72 A few.
310 A few.

IV. G.
195 Fry. Rather abundant.
402 Immature and also much fry.

V. E.
470 A few. Mature and immature.
438 A few. Immature.

V. G.
729 Fry rather abundant.
592 Fry rather abundant and also some immature specimens.

Setipinna taty is of great importance for the fisheries. The species seems to prefer a muddy bottom. From the data given above it follows, that they are lacking in the area with a sandy bottom near Panipahan. On the submarine continuation of the central bank they are very abundant and the specimens are mostly mature, whereas on the central bank itself they are rare and these specimens are immature. Between Pulu Halang Běsar and the maincoast they also occur in big numbers as is apparent from the catch of jeremal 520. We can draw a line from the northern point of Pulu Halang Běsar to jeremal 571 and from this to jeremal 171 and 602 further along the coast to jeremal 421. Between Pulu Halang Běsar and the maincoast this line must be drawn between jeremal 520 and 470. Outside this line *Setipinna taty* occurs in big numbers and the specimens are mature for the greater part. (Except jeremal 521, where I found some fry also). At the inner side of the line *Setipinna taty* is mostly immature and is rare in the various catches and in the jeremals near the maincoast of Bagan Si Api Api young fry is taken in rather large quantities. (i.e. jeremal 602 in III G, 195 in IV G and 729 and 592 in V G). The young *Setipinna*'s evidently prefer the coastal parts of the fished area and especially that part, that is situated near the rivermouth proper.

TABLE I. *Setipinna taty* C. V. [1]).

Length.	N.	4.	5.	6.	7.	8.	9.	10.	11	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.
J. 104	39		4	20	15															
J. 521	75								1	28	29	15	3	1						
J. 571	56							2	10	17	22	4	1							
J. 676	181	2	5	13	30	45	12	5	12	31	15	8	2	1						

In Table I one can see clearly the difference in length and therefore also in maturity of the *Setipinna*'s caught in the jeremals which are situated nearer or farther away from the rivermouth.

In jeremal 104, situated at the coastal side of the line mentioned above, most of the fishes have a length of about 6 cm and in jeremals 521 and 571, situated outside the line, the greater part have a length of about 12—13 cm. Jeremal 676 shows a doubletopped curve. Here mature and immature animals were caught together. Evidently we have here an area where the two stages are mixed together.

Setipinna taty reaches maturity at a length of about 12 cm.

8. **Engraulis kammalensis** (BLKR.).

I. E.
515 A few.

II. D.
315 Rather abundant. Mature and immature.

II. E.
117 Rare. Mature and immature.

II. F.
776 A few. Mature.

II. G.
686 Abundant. Immature.

II. H.
248 Rather abundant. Mature.
521 Rare. Mature.

II. I.
756 A few.

III. C.
84 Rare.

III. D.
68 Rare. Immature.

III. E.
218 A few. Mature.
571 Rather abundant. Mature.

III. F.
171 Very abundant. Mature.
103 Rare.
559 Rather abundant. Mature.
901 Rather abundant. Mature.

III. G.
562 A few.
602 A few. Mature. Some fry.
652 Rare. Mature.

III. I.
421 A few. Mature and immature.

III. J.
Si Tsji Seneboei. A few.

[1]) In this and in the following tables the length of the fishes is given in cm. The numbers 4 means a length of 4 - 4.9 cm, the number 5 a length of 5 - 5.9 cm and so on.

IV. D.
676 Rare. Immature.

V. E.
438 Rare. Immature.

IV. F.
104 Rare. Immature.
389 Rare. Immature.
310 Rare. Immature.

V. G.
729 Fry abundant.
592 Fry abundant.

IV. G.
153 A few. Immature.
195 Fry, rather abundant.
402 Fry, rather abundant.

Engraulis kammalensis, which is often found in front of the rivermouths, has about the same area of distribution as *Setipinna taty,* but is less abundant. This species is absent also along the coast in the neighbourhood of Panipahan, but the boundary line is much more to the south than is the case with *Setipinna taty,* which is frequent at the jeremals 86 and 68 whereas *E. kammalensis* is only rarely caught and moreover the specimens are immature. The main area of distribution is the submarine continuation of the central bank, but the inner limit of the abundant occurrence of ripe fishes is here nearer to the coast than with *Setipinna taty.* This species is caught in abundance for instance in the area of the jeremals 571 and 171, which are situated in the boundary zône of *Setipinna taty.* On the other hand the boundary in section III G seems to lie more seaward, and is to be found somewhere between jeremal 652 and 686, which is also the case in section II H where the line has to be drawn somewhere between jeremal 521 and 248. It is evident that *E. kammalensis* lives in places where the muddy bottom is still relatively soft, as in sections I D, E, F, en H where the mud is much harder, this fish is relatively rare or absent. It is caught therefore only sporadically in the region N. E. of the central bank. Only in the catch of jeremal 248 the species occurs in a somewhat greater quantity. At the inner side of the boundary zône mentioned above *E. kammalensis* is much less common and immature, and the jeremals situated near the coast of Bagan Si Api Api and those in front of the rivermouth take young fry in a relatively great abundance. (i.e. Jeremal 602, 195, 402, 729 and 592).

In October the catches of *E. kammalensis* in general were much smaller as was also the case with the young fry. Young *Engraulis dussumieri* on the other hand was taken in greater quantities.

TABLE II *Engraulis kammalensis* BLKR.

Length.	N.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
J. 571	59						23	32	4			
J. 104	38	4	30	4								

In Table II the difference in size and thus in maturity inside and outside the boundary zône is very clearly to be seen.

This species reaches maturity at a length of about 9.5—10 cm.

9. **Engraulis grayi** (BLKR.).

II. D.	III. E.
780 One specimen. Mature.	571 A few. Mature.

This species is very common in the Archipelago, but at Bagan Si Api Api it seems to be an occasional guest only.

10. **Engraulis mystax** (BL. SCHN.).

III. E.	III. J.
571 A few. Mature.	Si Tsji Seneboei. Rare. Immature.

This species is also very common in the Archipelago, but is practically absent in the fished area of Bagan Si Api Api, where it was caught in small numbers only near Seneboei. It is therefore remarkable that *E. grayi* as well as *E. mystax* were to be found in the catch of jeremal 571.

11. **Engraulis dussumieri** (C. V.).

I. E.	I. F.	II. D.
844 A few. Mature.	753 A few. Mature.	315 A few. Mature.
II. E.	II. G.	II. H.
117 A few. Mature.	790 A few. Mature.	404 Abundant. Mature.
		248 Rare. Mature.
		521 A few. Mature.
III. D.	III. E.	III. G.
68 A few. Mature.	218 A few. Mature.	602 A few.
	571 Rare. Mature, and immature.	

This species, rather common in the whole Indo-Australian Archipelago seems to be more or less euryhaline. I found it more than once in front of rivermouths. In January I did not find it in as large a quantity as in October, although even in the latter month it was not common.

In October I found many specimens in the adjacent mouth of the Panei river. Not much can be said about the distribution of this species in the area of Bagan Si Api Api. Anyhow the main area of distribution is lying north and north-east of the central bank and a few specimens had gone astray in the brackish water as far as jeremal 602. In the area with sandy bottom in front of Panipahan I did not find a single specimen.

This species is mature at a length of about 10 cm.

12. **Stolephorus tri** (BLKR.).

II. G.

790 2 specimens. Mature.

This species is very common in front of the rivermouths of Sumatra (e.g. the mouths of the Panei, Indragiri and Moesi).

Off Bagan Si Api Api, however, I did not find more than the two specimens mentioned above. Yet it is evident from the planctoncatches made by Prof. DELSMAN, that the species spawns outside the fishing area of Bagan Si Api Api, as planctonic eggs were found in large numbers. The bulk of the specimens seems to live therefore outside the jeremal area. Why this species lives so far in sea in front of the mouth of the Rokan I do not know. In the other rivers named above the species goes much further upstream.

13. **Stolephorus baganensis** Nov. spec. [1])

I. D.	I. E.	I. F.	II. B.
781 A few. Immature.	515 A few. Mature.	753 A few.	778 A few.

II. D.
780 A few. Mature. Some young fry.
315 A few. Mature and immature.

II. E.
117 Rare. Mature.

II. F.
567 A few.
776 A few. Mature, much immature.

II. G.
658 A few.
686 Rather abundant. Mature and immature.
790 Rare. Mature.

II. H.
521 Rather abundant. Mature, immature, some fry.
404 A few.
248 Rare. Mature and immature.

II. I.
756 A few.
774 Rare. Mature and immature.

III. C.
546 Rare. Juvenile.
86 Rare. Mature and immature.
84 A few.

III. E.
787 Rather abundant. Also some fry.
218 Rare. Mature.
120 A few.
571 A few.

III. F.
171 Rare.
103 A few.
559 Rather abundant. Mature.
901 Rather abundant. Mature and immature.

III. G.
652 One specimen.
562 A few.
X_1 A few. Mature and immature.
602 A few. Mature. Some young fry.

III. I.
421 Rare. Mature.

[1]) A full description will be published in a short time.

III. J.
Si Tsji Seneboei. Rare. Mature and immature.

IV. D.
676 A few.

IV. E.
520 Rare. Mature.

IV. F.
72 A few.
389 Rare.
310 A few. Mature.
104 Rather abundant. Immature and mature.

IV. G.
195 Fry.
298 A few.

V. E.
470 Some mature specimens. Much fry.

V. G.
729 Immature and mature. Some fry.
592 Mature. Some fry.

This species, which is to be found regularly in front of the mouths of the big rivers, occurs in the whole area of Bagan Si Api Api. From investigations not yet published, it appears that two different races can be distinguished in the sea in front of Bagan Si Api Api, races which can be separated also by their planctonic eggs as was pointed out by Prof. DELSMAN. (See Treubia Vol. XIII 1931).

One race (A) proved to live much nearer to the coast than the other race (B) which lives farther out in the sea. I prefer not to separate the two races in the list of catches given above. In the whole area, besides bigger individuals which can be distinguished from each other, smaller individuals are also caught, which cannot be distinguished at first sight. It is practically impossible to separate the young individuals and the fry of the two races. From the plancton investigations by Prof. DELSMAN it appeared that the planctonic eggs of the race B were found farther out at sea than the eggs of the race A. I suppose, therefore, that the young specimens and the fry caught in the whole sections I and II belong mainly to race B and that the young individuals and the fry, which are caught on the central bank, belong to race A. Individuals belonging to race B, as far as they can be distinguished are rarely caught, apparently because the main area of distribution lies outside the fished area. Clearly recognizable specimens of races B were found in the following catches.

I. D.
781 Immature.

II. D.
780 Mature.

III. H.
521 Mature.

III. G.
652 One specimen only.

III. I.
421.

Stolephorus baganensis reaches maturity at a total length of about 7 cm. This holds for both races.

14. **Coilia dussumieri** C. V.

I. D.
781 A few. Mature and immature.

I. E.
515 Rare. Mature and immature.

I. F.
753 Abundant. Mature.

I. H.
845 Abundant. Mature.

II. B.
X_3 Rare.

II. D.
173 Abundant. Mature
315 Rather abundant. Mature.
780 Rare. Mature and immature.
259 A few.

II. E.
117 Rather abundant Mature.

II. F.
567 Abundant. Mature.
776 Rather abundant. Mature.

II. G.
658 Rather abundant. Mature.
686 A few. Mature.
790 Very abundant. Mature.

II. H.
809 Abundant. Mature.
404 A few.
248 Rather abundant. Mature and immature.
521 Rather abundant. Mature.

II. I.
744 Rather rare in January.
Abundant in October. Mature.

III. C.
546 A few. Mature.
86 Rare. Mature.
84 A few.

III. D.
68 A few.

III. E.
218 A few. Immature.
571 A few. Immature.

III. F.
171 A few. Immature.
559 A few. Mature.

III. G.
652 A few. Immature.
X_1 A few.

III. J.
Si Tsji Seneboei. Rare.
Mostly mature.

IV. D.
X_2 Abundant. Mature.
676 A few. Mature and immature.

IV. E.
520 A few. Immature.

IV. F.
310 A few.

The area of distribution of *Coilia* is about the same as that of *Setipinna taty*. *Coilia* is rare or absent in the part with a sandy bottom near Panipahan. The same is the case on and about the central bank. The species is also rare in the area n.w. of Pulu Halang Bĕsar (III C and D and IV D) where *Setipinna taty* is common. (Only jeremal X_2 shows a larger quantity of *Coilia* in the catch). As a matter of fact only the jeremals in the sections I and II show big catches of *Coilia*. The jeremals in section III mostly catch a few individuals only and south of the line from the northpoint of Pulu Halang Bĕsar to jeremal X_1 and 744 *Coilia* is never caught (except J. 310 in IV F). It seems therefore that *Coilia* avoids the very muddy water above the soft muddy bottom of the central bank.

It strikes one, that the jeremals north of the central bank in section III take mostly immature specimens, as is the case with *Setipinna taty*. I did not find juvenile specimens, smaller than about 5 cm, or young fry, neither in January nor in October.

The young fry of *Coilia* seems therefore to live outside the fished area. Yet it is evident that the spawning area is not far away, considering the big number

of ripe specimens, that is caught every day. Dr. DELSMAN has found the pelagic eggs in great quantities and will shortly publish an article on this subject.

Coilia dussumieri reaches maturity at a length of about 10 cm.

15. **Clupeoides lile** (C. V.).

II. G.	III. C.	III. D.	III. E.
686 A few.	86 1 specimen. Immature.	68 A few.	787 A few. Mature.
		69 A few.	218 Rather abundant. Mostly mature.

III. G.	IV. F.	V. E.
652 1 specimen. Immature.	104 1 specimen. Mature.	470 A few. Immature.
602 1 specimen. Immature.		

V. G.
592 A few. Immature.

This species is of no importance as a component part of the fauna. Mostly a few individuals only are caught and only in the catch of jeremal 218 *Clupeoides* was to be found in a larger quantity. Nothing can be said with certainty about the distribution. Yet it is a remarkable fact, that this species goes into waters with such a low salinity. (V E and G!).

Clupeoides lile reaches maturity at a length of about 8.5 cm.

16. **Clupea toli** C. V.

I. F.	II. B.	II. D.	II. E.	II. G.
753 A few.	X_3 A few.	259 A few.	117 One specimen.	790 2 specimens.
		780 A few.		

II. H.	III. C.	III. D.	III. E.	III. F.
521 A few.	86 1 specimen.	68 A few.	218 A few.	559 A few.
			571 1 specimen.	

III. G.	III. I.	IV. D.	IV. E.	IV. F.
652 1 specimen.	421 A few.	X_2 1 specimen.	520 A few.	71 1 specimen.
602 1 specimen.		676 A few.		310 1 specimen.

IV. G.
298 A few.

This species which furnishes the very important article of trade "troeboek" (fishspawn), is caught only sporadically in the sea off Bagan Si Api Api. I always saw young specimens up to a length of about 20 cm, and never more than a few individuals together. This Clupeid seems to live solitarily, as never more than one individual is caught at the same time. At the fishmarket of Bagan Si Api Api, however, I saw one mature individual, but I could get no information about the exact place, where it had been caught. I can say nothing in particular about the distribution in the fished area. The area in front of the proper rivermouth seems to be avoided.

17. **Clupea macrura** (BLKR.).

II. D.	II. E.	II. G.	II. H.
315 1 specimen.	117 1 specimen.	790 2 specimens.	521 1 specimen.
III. E.	IV. E.		
218 1 specimen.	520 1 specimen.		

This species, which is much rarer than *Clupea toli,* is also caught in young specimens only and never more than one or two individuals are found in the catch.

Along the whole coast of Sumatra *Clupea toli* is much more common than *Clupea macrura.*

18. **Clupea kanagurta** (BLKR.).

I did not see this species myself. It was found by Prof. DELSMAN in a jeremalcatch near Panipahan. (Collection DE WAART 1922).

19. **Pellona amblyuropterus** BLKR.

II. D.	II. F.	II. G.
173 A few. Immature.	567 A few. Immature.	686 1 specimen. Immature. 790 A few. Immature.
II. H.		III. G.
521 A few. Mature and immature.		602 A few. Immature. 562 1 specimen.
III. J.	III. I.	IV. D.
421 A few. Immature.	Si Tsji Seneboei. A few.	676 1 specimen. Immature.
IV. F.		
104 Very rare. Immature.		

Pellona amblyuropterus is relatively rare. I found never more than a few specimens together in one catch. I think therefore, that this and the other species of the genus *Pellona* are solitary species. *P. amblyuropterus* is of no importance at all for the fisheries. About the distribution I can only say, that the central bank seems to be avoided. All specimens were young (10—15 cm) with a single exception in jeremal 521 (see above). At which length this species is mature I could not ascertain, as I got no transitional stages. *P. amblyuropterus* and *P. ditchoa* are the commonest species of the genus in the sea off Bagan Si Api Api.

20. **Pellona ditchoa** C. V.

I. E.	I. F.	II. E.
844 A few. Mature.	753 A few. Mature.	117 1 specimen. Immature.
II. H.	III. J.	
248 A few. Immature.	Si Tsji Seneboei. A few. Immature.	

About this species the same can be said as about *Pellona amblyuropterus.*

21. **Pellona pristigastroides** BLKR.

II. H.	III. E.	III. G.
521 1 specimen.	218 Rare. Immature.	652 1 specimen. Immature.
		IV. D.
		676 1 specimen. Immature.

This species, very rare off Bagan Si Api Api and elsewhere in the Archipelago, is of no importance as part of the fauna. I only saw immature animals.

22. **Pellona dussumieri** C. V.

I. E.	I. F.
515 2 specimens. Immature.	751 1 specimen. Immature.

Very rare species. As was the case with the other *Pellona* species, I found young individuals only.

Mature specimens of the genus *Pellona* seem therefore to live outside the fished area.

In the jeremals 602, 195, 103 and 592 I found some fry of *Pellona*. I was not able to make out the species.

23. **Opisthopterus tartoor** (C. V.).

I. F.	II. F.	III. E.
753 1 juvenile specimen.	567 1 juvenile specimen.	787 A few juvenile specimens.

Very rare. I did not find this species in any other rivermouth of Sumatra either.

24. **Raconda russelliana** GRAY.

I. D.	I. E.	I. F.
781 Abundant. Mostly immature.	844 Rare. Mature.	753 Rare. Mature.
	515 A few.	

I. H.	II. D.	II. F.
845 A few. Immature.	173 Rare. Mostly mature.	567 1 specimen. Mature.
	315 A few. Immature.	
	780 A few. Mature and immature.	

II. G.	II. H.
790 A few in January / Rather abundant in October. } Mature.	809 A few.
	248 A few. Mature.

III. C.	III. D.
546 A few. Immature.	68 Rare. Immature. In January.
84 A few. Immature.	Rather abundant. Immature. In October.
	69 A few.

III. E.

787 A few. Juvenile.
218 Rare. Mature.
571 A few. Juvenile.

III. G.

602 A few.

IV. D.

676 A few. Immature.
X_2 Abundant. Mature.

Raconda is much more common than the allied genus *Opisthopterus* and therefore it is more important as a part of the fauna. The distribution, as a whole, is about the same as that of *Setipinna taty*.

The species is absent in the area with sandy bottom near Panipahan and in the area of the central bank with the soft-muddy bottom. *Raconda* seems to be more susceptible to muddy water, than *Setipinna*. (It is possible, of course, that it is a susceptibility to the salinity also, but this is very difficult to decide in this case, as the water has a lower salinity wherever the muddiness is greater). Therefore the species is absent in IV E and in III F-J. (Except a few astrayed animals in III. G, 602), where *Setipinna taty* is found rather regularly though not in great numbers. The limit for *Raconda* is found more seaward, from jeremal 676 (IV D) to 571 (III. E.) and from there to the sections II. F, G and H. In these regions the species is rather regularly found though seldom in considerable numbers. Nothing can be said with certainty about a regional distribution of mature and immature specimens. Young fry is found sporadically.

This species reaches maturity at a length of about 16 cm.

Fam. Scopelidae.

25. **Harpodon nehereus** (HAM. BUCH.).

I. E.

515 Rare. Immature.
844 Rare. Mature.

I. F.

753 A few. Mature.

I. H.

845 A few.

II. D.

173 Rare. Mature and immature.
315 Rare. Mature.
259 A few.

II. E.

117 Rather abundant. Mature.

II. F.

567 Rare. Immature and mature.
776 Abundant. Mature.

II. G.

658 Abundant. Mature and immature.
686 Rather abundant. Immature.
790 A few.

II. H.

809 A few.
404 A few. Mature.
248 A few.
521 Abundant. Mature and immature.

II. I.

774 A few. Mature

III. C.

546 Rare. Mature.
86 Rather abundant. Mature and immature.
89 A few.

III. D.

68 A few. Immature.

III. E.
787 A few.
218 A few. Immature.
571 A few. Immature.

III. F.
171 A few. Immature.
559 Rare. Immature.
901 A few.
104 Rather abundant. Mostly immature.

III. G.
652 Abundant. Immature.
562 Rather abundant. Mature and immature.
X_1 A few.
202 A few.
602 Rather abundant. Mature and immature.

III. H.
414 A few.

IV. D.
676 A few. Mature and immature.

IV. E.
520 A few. Immature.

IV. F.
72 A few.
389 A few.
310 Abundant. Immature.
Si Tsji Halang.

IV. G.
293 A few.
195 Very abundant. Immature.
122 A few.
298 Abundant. Immature.

V. E.
470 A few. Immature.
438 A few.

V. G.
592 A few. Immature.

Harpodon has little importance for the fisheries. As a consequence of the great percentage of water in the muscles the quantity of salt required for conservation is too great. Yet this species is a very important part of the fauna.

Harpodon is very euryhaline and seems to prefer a muddy bottom. The species is caught throughout the fished area and only in the part with sandy bottom near Panipahan it is wholly absent.

The distribution is rather irregular in the area inhabited and I see no special factor on which this depends. Typical in this regard is for instance the list of jeremals in section IV G (see above). Yet I got the impression, that in the jeremals farther away from the coast, *Harpodon* is rarer, as can be seen in the list of jeremals given above. In examining the different catches I was struck by the fact, that the individuals are bigger when the jeremal is more distant from the coast, and only in the sections I, II and III one can find mature animals (jeremal 676 in IV D expected).

Thus I found in jeremal 521 for 114 specimens lengths from 10—22½ cm but most animals had a length of 16—19 cm. In measuring 76 specimens from jeremal 602 I found lengths ranging from 13—22½ cm and again the majority of the specimens measured from 16—19 cm. In jeremal 104 16 animals were measured and their lengths varied from 9—24 cm but the majority measured 13—15 cm and 38 specimens out of the catch of jeremal 195 had lengths varying from 5—9 cm with a maximum at 6—7 cm. See table III.

TABLE III. *Harpodon nehereus* (HAM. BUCH.).

Length.	N	4.	5	6.	7.	8	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.
J. 521	114							1			2	4	7	12	22	37	15	9	3	2			
J. 602	76										1	3	5	8	9	11	23	5	10	1			
J. 195	38			15	16	5	1																
J. 104	76						1	2		4	13	19	14	9	3	7				1		1	

Specimens with lengths below 5 cm were found in small numbers scattered over the central bank.

This species reaches maturity at a length of about 18 cm.

Fam. Siluridae.

26. **Silurichthys phaiosoma** (BLKR.).

This species is mentioned by WEBER and DE BEAUFORT for Bagan Si Api Api in their "Fishes of the Indo-Australian Archipelago". (Vol. II p. 197). I did not see it myself.

27. **Cryptopterus hexapterus** (BLKR.).

V. G.
592 Rather abundant. Immature.

Cryptopterus hexapterus is properly speaking a freshwaterfish, which descends especially at low tide into the estuary. According to the fishermen the jeremals in the river near Pulu Pĕrdamaran often have this highly esteemed food fish in their catches.

Fam. Plotosidae.

28. **Plotosus canius** HAM. BUCH.

II. H.	III. C.	III. G.	V. G
248 A few specimens.	84 1 specimen.	652 1 specimen.	592 A few specimens.

Besides the places mentioned above *Plotosus* is often caught in the river-jeremals near Pulu Pĕrdamaran, from where fresh specimens are brought every day to the fishmarket at Bagan Si Api Api. This species is therefore very euryhaline.

Fam. Pangasidae.

29. **Pangasius nasutus** (BLKR.).

V. G.
592 Some young specimens and a few very big ones (60—70 cm).

This species is properly speaking a freshwaterfish, but descends into the sea at low tide.

These and other riverspecies are mostly caught at the end of the tide when the water has reached nearly its lowest level. When the tide is coming in they ascend the river again. I got information that these species are caught abundant-

ly at neap tide, when there is only a relatively small quantity of seawater mixed up with the freshwater from the river. The same should be the case where after heavy downpours of rain, the river brings large quantities of freshwater down into the sea and when the salinity consequently is very low.

30. **Pangasius polyuranodon** (BLKR.).

III. G.
651 1 specimen. Mature.
562 1 specimen. Mature.

V. G.
592 Some mature specimens.

This is also a freshwaterfish, but it seems that some individuals go into the brackish water and even far out into the sea where I found it at a salinity of 15—20$^0/_{00}$ (section III G!). Evidently, then it goes much farther out than *Pangasius nasutus*.

Fam. Ariidae.

31. **Arius argyropleuron** C. V.

This species is mentioned for Bagan Si Api Api by WEBER and DE BEAUFORT. (Vol. II pag. 279). I did not see a single specimen.

32. **Arius maculatus** (THUNB.).

V. G.
592 Rather abundant. Mature and immature.

I found this species in jeremal 592 only, in front of the rivermouth. According to WEBER and DE BEAUFORT this species lives in rivers as well as in the sea and therefore one can expect this species in the jeremals farther in the sea also. A very euryhaline fish.

33. **Arius sagor** (HAM. BUCH.).

II. H.
521 1 specimen.

V. G.
592 Some mature specimens.

This is a very euryhaline species too, as it lives in rivers as well as in the sea.

34. **Arius macronotacanthus** BLKR.

IV. F.
104 1 specimen.

Very rare in the fished area. WEBER and DE BEAUFORT give as habitat "sea and rivers".

35. **Arius caelatus** C. V.

This species, which I did not see, is mentioned by WEBER and DE BEAUFORT (Vol. II pag. 310). It lives in the sea and in rivers.

36. **Arius doriae** Vinc.

II. H.	V. G.
248 1 specimen.	592 1 specimen.

This species, hitherto known from Serawak only, is rare in the area. It seems to be very euryhaline too.

37. **Ketengus typus** Blkr.

V. G.
592 1 juvenile specimen.

According to Weber and de Beaufort a freshwater species, which descends into the brackish water of the estuaries.

38. **Hemipimelodus macrocephalus** Blkr.
I found one specimen at the fishmarket in Bagan Si Api Api. The actual place where it was caught, sea or river, is unknown to me. According to Weber and de Beaufort it is a freshwater species.

39. **Osteogeneiosus militaris** (L.).

II. H.	III. G.	III. I.
248 2 specimens.	602 1 specimen.	Si Tsji Seneboei. A few.
IV. G.	V. G.	
195 A few.	592 A few.	

A euryhaline species, which may be found in front of the mouth of other rivers too. According to Weber and de Beaufort a marine species, which sometimes ascends the rivers.

Fam. Bagridae.
40. **Macrones wolffi** (Blkr.).

V. G.
592 2 specimens.

A river species, sometimes descending into the estuaries.

41. **Macrones nemurus** (C. V.).

V. G.
729 A few.
592 A few.

About this species the same can be said as about *Macrones wolffi.*

42. **Macrones micracanthus** (Blkr.).
This very common freshwater species is mentioned by Weber and de Beaufort for Bagan Si Api Api. (Vol. II. p. 339).
I did not succeed in getting a single specimen.

Fam. Cyprinidae.

43. **Rasbora argyrotaenia** (BLKR.).

This species is mentioned for Bagan Si Api Api by WEBER and DE BEAUFORT (Vol. III p. 61). I did not see a single specimen, although I got several specimens from the mouths of Borneo rivers.

44. **Leptobarbus hoevenii** (BLKR.).

V. G.
592.

A river species, descending sometimes into the estuaries. It is mentioned also by WEBER and DE BEAUFORT (Vol. III p. 96).

45. **Osteochilus melanopleura** (BLKR.).

V. G.
592.

A river species too, descending sometimes into the brackish waters of the rivermouth.

46. **Osteochilus spilurus** (BLKR.).

V. G.
729.

About this species the same can be said as about *Osteochilus melanopleura*.

47. **Puntius hexazona** (WEBER and DE BEAUFORT.).

This species is mentioned by WEBER and DE BEAUFORT (Vol. III. p. 181). I did not see it.

Fam. Congridae.

48. **Muraenesox cinereus** (FORSK.).

I. E.	II. H.
844 1 specimen.	248 1 specimen.

Muraenesox cinereus is regularly found in the different estuaries of Sumatra, though always a few specimens only. WEBER and DE BEAUFORT mention this species for Bagan Si Api Api. (Vol. III p. 253).

49. **Muraenesox talabon** (CANTOR).

II. D.	II. E.	II. G.	III. C.
315 1 specimen.	117 A few.	790 A few.	86 1 specimen.
780 1 specimen.		686 2 specimens.	
III. E.	IV. G		
218 A few.	195 1 specimen.		

Evidently this species is more common than *M. cinereus* and specimens of all lengths are caught from a few dm up to a length of 1.5 m.

It is distributed over the whole area, but the central bank and the proper mouth of the Rokan is avoided. This species is also to be found regularly in front of any other rivermouth.

WEBER and DE BEAUFORT mention this species for Bagan Si Api Api too (Vol. III p. 255).

During my residence in Bagan Si Api Api I thought that only one species of *Muraenesox* occurred in the fished area. Therefore I did not preserve every specimen I got. Thus from my notes it is not possible to decide which of the two species was caught. I found specimens of which I cannot give the species name, in the catches of the following jeremals.

II. D.	II. E.	II. G.	III. C.	III. E.	III. G.
780	117	686	86	218	X_1

Fam. Neenchelidae.

50. **Neenchelys buitendyki** WEBER and DE BEAUFORT.

II. D.	III. G.
315 1 specimen.	602 A few.

A very rare species, which is of no importance at all as a component of the fauna.

Fam. Ophichthyidae.

51. **Ophichthys macrochir** (BLKR.).

II. D	III. E.	IV. D.	IV. F.
315 1 specimen.	787 1 specimen.	676 1 specimen.	310 1 specimen.

Besides the places mentioned above, I found this species at the fishmarket. It is to be found in the mouth of other rivers too. WEBER and DE BEAUFORT mention this fish for Bagan Si Api Api (Vol. III p. 306).

Fam. Belonidae.

52. **Tylosurus strongylurus** (v. HASS.).

II. B.	II. G.	III. E.	III. G.	III. I.
X_3 A few.	790 A few.	218 1 specimen.	652 A few.	421 A few. Juvenile.
		571 A few.	562 A few.	
			602 A few.	

III. J.
Seneboei. Si Tsji. A few.

Tylosurus strongylurus swims in little shoals of about 10—20 specimens, and mostly the whole shoal is caught at once. The species avoids the central bank and seems to frequent the eastern part of the Eastern Border Area. WEBER and DE BEAUFORT mention this species for Bagan Si Api Api (Vol. IV p. 121).

53. **Tylosurus annulatus** (C. V.).

II. B.
X_3 1 specimen.

I got only one specimen of this species, which is widely distributed throughout the Archipelago.

Fam. H e m i r h a m p h i d a e.

54. **Hemirhamphus georgii** C. V.

II. B.	II. D.	II. E.	II. G.	II. H.	III. C.
778. A few.	173 A few.	117 A few.	790 A few.	248 A few.	546 A few.
	780 A few.				

III E.	III. G.	IV. D	IV. F.
218 A few.	562 A few.	676 A few.	310 A few.
120 A few.	602 A few.		

H. georgii swims in little shoals of about 10—20 specimens. They live in the whole fished area outside the central bank. (Jeremal 310 excepted!). I found this species in front of different other rivermouths of Sumatra and Borneo. This species is euryhaline. WEBER and DE BEAUFORT mention it for Bagan Si Api Api.

55. **Hemirhamphus gaimardi** C. V.

II. G	III. C.	III. E.	III. I.
686 1 specimen.	86 2 specimens.	787 A few.	421 1 specimen.
		571 1 specimen.	

Unlike *H. georgii* this species lives solitarily. This area of distribution is again outside the central bank. This species of the genus *Hemirhamphus* seems therefore to avoid the very muddy water. WEBER and DE BEAUFORT mention this species for Bagan Si Api Api. (Vol. IV p. 150).

56. **Hemirhamphus marginatus** (FORSK.).

II. G.	III. C.
790 1 specimen.	86 1 specimen.

Very rare in the area of Bagan Si Api Api.

57. **Dermogenys sumatranus** (BLKR.).

This is a river-species mentioned by WEBER and DE BEAUFORT for Bagan Si Api Api. (Vol. IV p. 139).

58. **Zenarchopterus ectunctio** (HAM. BUCH.).

One specimen caught in the planeton-net in the roadstead of Bagan Si Api Api.

59. **Zenarchopterus buffoni** (C. V.).

III. E.

218 1 specimen.

I found one specimen only, with a reversed colourpattern as the ventral side was dark- and the dorsal side was lightcoloured. I can not say anything about the meaning of this peculiarity.

BEEBE in his "Fishes of Haiti" (Zoölogica Vol. X No. 1) mentions the same fact for young specimens of *Strongylura rhapidoma* (RANZANI).

Fam. P o l y n e m i d a e.

60. **Eleutheronema tetradactylum** (SHAW).

I. D.
781 A few. Immature.

I. E.
515 A few. Immature.
844 A few. Immature.

II. B.
778 A few. Immature.

II. D.
173 Rare. Immature.
315 Rare. Immature,
1 spec. Mature.
259 A few. Immature.

II. F.
567 A few. Immature.

II. G.
686 Rare. Immature. 1 specimen mature.
790 A few. Immature.

II. H.
248 Rare. Immature.
521 Rare. Immature.

II. I.
756 A few. Immature.
774 A few. Immature.

III. C.
84 A few. Immature.
86 Rare. Immature.

III. D.
68 A few. Immature.

III. E.
218 Abundant. Immature.
571 Rather abundant. Immature.

III. F.
171 Rare. Immature.
559 Rare. Immature.
901 A few. Immature.

III. G.
652 Rather rare. Immature.
562 Rather rare. Immature.
X_1 A few. Immature.
602 Abundant. Immature.
202 Abundant. Immature.

III. H.
414. A few.Immature.

III. I.
421 Very abundant. Immature. 1 spec. mature.

IV. D.
676 Rare. Immature.

IV. E.
520 Rare. Immature.

IV. F.
72 Rather rare. Immature.
104 Rather abundant. Immature.
389 A few. Immature.
310 Rare. Immature.
Boeboes Halang. Rare. Immature.

IV. G.
293 Rather abundant. Immature.
195 Abundant. Immature.
122 Rather abundant. Immature.
298 Rather abundant. Immature.
402 Rare. Immature.
153 Abundant. Immature.
253 Rather abundant. Immature.
153 Rather abundant. Immature.

V. E.
438 A few. Immature.
470 Rare. Immature.

V. G.
592 Rare. Immature.
729 Abundant. Immature .

Eleutheronema tetradactylum is a very important factor of the fauna of the Rokanmouth and therefore very important for the fisheries too. As may be seen from the data given above, all are immature and from time to time only a single ripe specimen is caught in the jeremals far away from the coast. The driftnet-fishermen, who fish outside the area of the jeremals, sometimes do take mature specimens too. Besides I have to draw attention to the fact, that all *Eleutheronema*'s which are caught have a length from about 5 to as much as 25 cm and that the ripe specimens had a length of about 60—70 cm. (One specimen of 42 cm with ripe gonads excepted). Intermediate lengths and lengths below 5 cm were absent altogether. I cannot tell yet whether this phenomenon is due to a periodicity in spawning or to the fact that the missing stadia live elsewhere, outside the fished area. The first supposition is not supported by the fact, that in January as well as in October, the same length-proportions were found.

As to the distribution I could state that *Eleutheronema* is rare in the area with sandy bottom off Panipahan and that the species is very common on and about the central bank only. In the eastern border-area *Eleutheronema* is rather rare, but it is regularly caught there in small numbers. Especially on the eastern part of the central bank this species is common, even so common that 90% of the catch sometimes consists of *Eleutheronema*. Jeremal 421 (III. I) also shows a very high percentage of the species in its catches.

Eleutheronema is common in the sections III. G., IV. F and G and V. G., and it occurs in big numbers in section III. E north-west of the central bank. In the section III. F. which connects III.E. with the other sections named above the species is much less common, but I think this is accidental only.

Eleutheronema seems to prefer water with a special percentage of salinity or mud. At least the jeremals to the seaward of the central bank, as for instance jeremal 218 and jeremal 521 (see p. 92) land the species especially at the end of the ebbtide, when the muddy water flows off from the central bank.

I give as an example the catchrecord of jeremal 218.

This jeremal starts fishing 1 à 1½ hour after the beginning of the ebbtide, at that time only the current flows in the direction of the long axis of the jeremal. Therefore, when at 10 a.m. the first catch was hauled in, the ebbtide had already begun 1½ hour before.

10 h. The catch consists chiefly of *Stromateus cinereus* and *Sciaena* species (*Sciaena vogleri, Sc. belangeri, Sciaena glauca*). *Sciaenoides biauritus* and some specimens of *Clupeoides lile*. Further a few specimens of *Kurtus indicus, Setipinna taty, Eleutheronema tetradactylum, Trichiurus muticus* and *savala, Pellona* spec., *Raconda russelliana, Harpodon nehereus* and *Stolephorus baganensis* were present. I found also one *Otolithus maculatus*, one *Gobioides anguillaris*, one *G. cirratus* and some prawns.

10 h. 55 m. The catch is practically the same with a little school of *Hemirhamphus georgii* (17 specimens), 2 specimens of *Setipinna breviceps,* one *Engraulis kammalensis,* one *Clupea toli,* one *Chirocentrus hypselosoma* and some *Coilia dussumierii.*

11 h. 35 m. On the whole the catch has the same composition. A few *Setipinna breviceps* and *Engraulis kammalensis* and *dussumierii.* Young *Stolephorus baganensis* is rather abundant. Again a few *Clupea toli* and now also *macrura. Stromateus cinereus* is caught in smaller numbers now. The water becomes very muddy.

11 h. 50 m. The numbers of the two species of *Gobioides* increase. More *Trichiurus* and *Sciaena* and *Sciaenoides.* A little school of *Hemirhamphus georgii.* Some young *Stolephorus baganensis* again and a few *Harpodon nehereus.* One specimen of *Muraenesox talabon. Setipinna taty* is rarer now and the specimens are smaller. (Note. This is in agreement with the conclusion drawn from the discussion on *Setipinna taty,* viz. that the young individuals live nearer to the rivermouth. These specimens go seaward with the ebb-flow and approach the coast again at high tide. It is therefore possible that the double-topped curve of the catch from jeremal 672 (see above. Page 104) is due to the fact, that the catches of the beginning and of the end of the ebbtide were mixed together. I did not stay on jeremal 676 during the whole time of catch, but I took only a sample at random). The numbers of *Stromateus* have much diminished.

12 h. 10 m. A good deal of *Eleutheronema* at once. Small *Trichiurus* is rather abundant. As in all catches mentioned above a few small *Raconda russelliana. Setipinna taty* and *Harpodon nehereus* have vanished. The number of *Clupeoides lile* is much smaller.

12 h. 15 m. Many *Eleutheronema.* Only a few *Clupeoides lile* now. One *Stromateus cinereus. Sergestes* is rather abundant at once. *Sergestes* is mixed with small specimens of *Gobioides* and *Cynoglossus monopus.*

Later catches show the same composition. Only the numbers of *Cynoglossus* are increasing.

The catchrecord shows clearly that *Eleutheronema* is more abundant, when the water, flowing off from the central bank, has reached the jeremal. We have seen the same fact with jeremal 521 (see above. Page 92). (Note. *Sergestes* species, which have their main area of distribution on the central bank, increase in numbers at the end of the tide for the same reasons as *Eleutheronema*).

As is the case with other species, the smaller specimens of *Eleutheronema* live nearer the coast and the rivermouth than the bigger ones. See Table IV.

Table IV. *Eleutheronema tetradactylum* Shaw.

Length.	N.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15	16.	17.	18.	19.	20.	21.
J. 195	37	6	23	1	4	2	1												
J. 571	15									2	6	2	2	1			1	1	

WEBER and DE BEAUFORT mention this species for Bagan Si Api Api. (Vol. IV p. 199).

I could not ascertain at which length the specimens of *Eleutheronema* are mature, as intermediate stadia between immature and mature animals, were absent.

61. **Polynemus indicus** SHAW.

III. E.
571 One young specimen.

This species is rather often caught by the driftnet fishermen outside the jeremal area. I did not see more than the one specimen mentioned above, but I hardly doubt the species will be caught from time to time in the jeremals far away from the coast.

62. **Polynemus dubius** BLKR.

IV. G.	V. G.
195 A few. Immature.	592 Rather abundant. Immature.
	729 A few. Immature.

From the data given above it seems that *Polynemus dubius* is a riverspecies as it is only and even rather abundantly caught in the jeremals near the mouth of the river and not in the jeremals farther away. WEBER and DE BEAUFORT, who mention this fish for Bagan Si Api Api. (Vol. IV p. 215), give as habitat "In rivers and sea".

Fam. Sphyraenidae.

63. **Sphyraena** spec.

I saw only one dried specimen in Bagan Si Api Api.

I could not determine the name of the species. Fishermen told me, that it is sometimes caught by the driftnet outside the jeremal area.

Fam. Mugilidae.

64. **Mugil dussumieri** C. V.

II. D.	II. G.	III. E	III. G
173 A few.	686 A few.	571 Rare.	652 A few. Immature.
			602 A few.
III. I.		IV. D.	IV. E.
321 A few. Immature.		676 A few.	520 A few.
V. G.			
592 Rather abundant. Mature and Immature.			

Mugil dussumieri seems to be a very euryhaline species, which perhaps ascends the rivers. I did not find this species near other rivermouths in Sumatra. WEBER and DE BEAUFORT mention the species for Bagan Si Api Api. (Vol. IV p. 235).

This species reaches maturity at a length of about 12 cm.

65. **Mugil cunnesius** C. V.

III. C.	IV. D.
86 A few. Immature.	676 A few. Immature.

Rare near Bagan Si Api Api. I did not find mature animals.

66. **Mugil seheli** FORSK.

V. G.
729 1 specimen

After WEBER and DE BEAUFORT, this is a freshwater species, which sometimes descends into the estuaries.

In jeremal 729, 253, 389 and 84 I found a number of very young specimens of a *Mugil.* I could not determine the name of the species with certainty.

Fam. Atherinidae.

67. **Atherina** spec.

I found in Bagan Si Api Api amongst a heap of other fishes one dried specimen. The species of this genus do not seem to occur in the mouth of the Rokan. I cannot guess the reason of this, as in the nearby mouth of the Panei river they are rather common.

Fam. Anabantidae.

68. **Sphaerichthys osphromenoides** CANESTRINI.

WEBER and DE BEAUFORT mention this species for Bagan Si Api Api. (Vol. IV p. 349). I did not see it.

69. **Betta anabatoides** BLKR.

I did not see this species either, but it is mentioned for Bagan Si Api Api by WEBER and DE BEAUFORT. (Vol. IV p. 357). I think that the authors got some stray specimens from the river.

Fam. Gadidae.

70. **Bregmaceros maclellandi** THOMPS.

III.	III. I.	III. J.
86 One specimen.	421 A few.	Si Tsji Seneboei.

This species is caught in clear as well as very muddy water.

Fam. Soleidae.

71. **Synaptura commersoniana** (LAC.) CANT.

This species is mentioned by WEBER and DE BEAUFORT for Bagan Si Api Api. (Vol. IV. p. 168). I did not see it.

72. **Cryptops coeca** Nov. spec. [1]).

III. E.	IV. G.
571 2 specimens.	253 3 specimens.

1) A description of this new species will be published in a short time.

From this species, which is very strongly adapted to live in the mud (no eyes, tentacles on the finrays, etc.) I found only 5 specimens in total from two different places on the central bank.

73. **Cynoglossus monopus** (BLKR.).

I. E.
844 A few.

II. D.
315 Rare. Mature.
173 Rare. Mature.

II. G.
686 Rather abundant. Mature.

II. H.
248 A few.

II. I.
774 Rare.

III. C.
86 Rare. Mature.

III. D.
69 A few.
68 A few.

III. E.
787 A few.
218 Rather abundant. Mature and immature.
120 Rather abundant. Mature and immature.
571 Abundant. Mature and immature.

III. F.
171 A few.
559 Rather abundant. Mature.
901 A few.

III. G.
652. Rare. Mature.
562 A few.

III. H.
414 Rare. Immature.

III. J.
Si Tsji Seneboei. A few.

X_1. A few.
602 Rare. Mature.

IV. D.
676 Abundant. Mature and immature.

IV. E.
520 Rare. Mature.

IV. F.
72 Rare.
104 A few.
389 A few.
310 Rather abundant. Mature.
Boeboes Halang. A few.

IV. G.
195 Rare. Mature and immature.
298 Abundant. Mature and immature.
402 Very abundant. Mature and immature.
153 Rare. Mature and immature.
253 A few. Mature and immature.

V. E.
470 Rare. Mature.
438 A few. Immature.

V. G.
592 A few. Mature.

This fish which constitutes sometimes an important percentage of the catch, lives principally on the central bank, thus in places with a very soft bottom. In the jeremals situated more to the seaward, on a harder bottom, the number of *Cynoglossus* in the catches diminishes gradually. This species seems to prefer muddy water with a relatively low salinity (15—25‰). As is the fact with *Eleutheronema tetradactylum*, the jeremals north of the central bank catch *Cynoglossus monopus* in big numbers at the end of the ebbtide only.

A definite limit cannot be given for the distribution of this species. *Cynoglossus monopus* is absent only in the area with a sandy bottom near Panipahan.

A boundary between the areas of mature and immature animals can not be given either. In the whole area of distribution one may find mature and immature animals together. Very small specimens and fry are to be found on the central bank only, but here too many specimens of all lengths occur in large quantities.

It is very remarkable, that I did not find *Cynoglossus monopus* in other rivermouths of Sumatra.

WEBER and DE BEAUFORT mention this species for Bagan Si Api Api. (Vol IV p. 197).

This species reaches maturity at a length of about 9 cm.

74. **Cynoglossus polytaenia** (BLKR.).

I found this species in the collection of DE WAART made in 1922. I do not know the exact place where it was caught.

75. **Cynoglossus lingua** H. B.

I. E.	II. D.	II. E.
515 One specimen.	259 A few.	117 A few. Mature.
II. F.	III. G.	
686 A few. Immature.	153 One specimen.	
790 One specimen.		

This species is much less common than *Cynoglossus monopus* and lives mainly in the area outside the central bank (except jeremal 153 in III G). This species is therefore very euryhaline. I found *C. lingua* also in other rivermouths of Sumatra and Borneo, always in small numbers.

WEBER and DE BEAUFORT mention this species for Bagan Si Api Api. (Vol. IV p. 203).

Cynoglossus lingua reaches maturity at a length of about 25—30 cm.

76. **Cynoglossus oligolepis** (BLKR.).

This species is mentioned by WEBER and DE BEAUFORT for the sea near Bagan Si Api Api. I did not succeed in getting a single specimen.

Fam. Centropomidae.

77. **Lates calcarifer** (BLOCH).

I saw one small specimen of this species at the fishmarket of Bagan Si Api Api. I did not succeed in getting information about the exact place where the animal had been caught. At any rate the species is very rare. In other rivermouths the fish is very common. Why it is absent here I did not know.

Fam. Serranidae.

78. **Serranus fuscoguttatus** (FORSK.).

III. G.

X_1 One specimen.

I did not see more than this single, very big, specimen.

Fam. Theraponidae.

79. **Therapon theraps** C. V.

II. H.	II. I.	III. G.	IV. G.
248 1 specimen.	756 1 specimen.?	602 1 specimen.	195 1 specimen.?
	774 1 specimen.		

Never did I see more than one specimen in a catch. This species is therefore very rare. At first sight I thought the animals to be specimens of *Therapon jarbua*, which is common everywhere, but examination at home showed, that the three specimens, which I had preserved, all belonged to *Therapon theraps*. Whether *Therapon jarbua* after all occurs near Bagan Si Api Api, I cannot say, but it is not impossible that one or both of the not preserved specimens (from jeremal 756 and 195) belongs to this species.

Fam. Pristipomatidae.

80. **Pristipoma maculatum** (BLOCH).

II. B.
X_3 One specimen.

I did not see more than a single young specimen. In the other rivermouths of Sumatra I did not find the species either, but I got it regularly from the rivermouths of Borneo.

81. **Pristipoma guoraca** (RUSSELL).

This species is rather often caught by the driftnet-fishermen outside the fished area. In the catches of the jeremals I never saw it but the outer ones will undoubtedly catch it from time to time.

Fam. Chaetodontidae.

82. **Scatophagus argus** (L.).

II. G.	II. I.	III. H.
686 1 specimen.	756 1 specimen.	414 1 specimen.

This species, so common elsewhere, seems to be rare near Bagan Si Api Api. It seems to prefer the eastern part of the area.

Fam. Mullidae.

83. **Upenoides sundaicus** BLKR. (?)

III. G.	III. J.
602 1 specimen.	Si Tsji Seneboei.

In each of these two cases I got a young specimen, which probably belongs to the above named species.

Fam. Sparidae.

84. **Crenidens** spec.

III. F.
559 1 specimen. Juvenile.

III. G.
602 1 specimen. Juvenile.

As I did not see older specimens, I could not determine the name of the species. This species is at any rate very rare.

85. **Proteracanthus sarissophorus** CANTOR.

II. I.
774 1 specimen.

Besides the specimen mentioned above, I saw several specimens at the fishmarket of Bagan Si Api Api. This species is rare in the mouth of the Rokan, but the jeremals in the mouth of the Panei do take it regularly.

Fam. Scorpaenidae.

86. **Leptosynanceia asteroblepa** BLKR.

III. E.
218 1 specimen.

III. G.
X_1 1 specimen.

V. G.
592 1 specimen.

The species of *Leptosynanceia,* occurring sometimes in the catches, are considered to be very poisonous by the fishermen and they are carefully thrown over board again.

87. **Leptosynanceia** spec.

III. E.
571

I could not see more than a single specimen. I could not determine the species name.

Fam. Kurtidae.

88. **Kurtus indicus** BLOCH.

I. D.
781 Rather abundant. Mature and immature.

I. E.
515 Abundant. Mature.
844 Abundant. Mature.

I. F.
753 Rather abundant. Mature.

II. B.
778 Abundant. Mature and immature.

II. D.
173 Rare. Mature and immature.
315 Rare. Mature and immature.
780 A few. Immature.
259 Rather abundant. Mature and immature.

II. E.
117 A few.

II. F.
567 A few. Immature.

II. G.
686 A few. Immature.
790 Rare. Mature and immature.

II. H.
248 Rather abundant. Mature and immature.
521 Rare. Mature and immature.

III. C.	III. D.	III. E.
546 A few. Mature.	68 Rare.	218 Rare. Mature.
86 Rare. Immature.		120 Rare.
84 Rare. Immature.		571 Rare. Mature and immature.

III. F.	III. G.	III. I.
559 Rare.	652 A few. Immature.	421 A few. Immature.
901 Rare. Immature.	602 Rare. Immature.	

IV. D.	IV. E.	IV. F.
X_2 A few.	520 Rare. Immature.	310 Rare. Immature.
676 Rare. Immature.		Boeboes Halang. A few.

IV. G.	V. E.
153 A few.	470 Abundant. Immature.
253 A few.	

Kurtus indicus is a very important part of the fishfauna of Bagan Si Api Api. It is regularly caught in great numbers. It is found in the whole fished area, where it is common everywhere. It has no special preference for a region with a sandy or muddy bottom, although it is not caught in the jeremals nearest the rivermouth.

In accordance with this, the number of individuals caught increases the more distant from the coast the jeremal is situated. One finds in the summary given above only the expressions "abundant" or "rather abundant" behind the numbers of the jeremals situated in the sections I and II. These differences in abundancy are perhaps due to the salinity or to the degree of clearness of the seawater.

It is evident also from the summary given above, that the younger specimens live nearer to the coast, than the mature ones. Mature (side by side with immature-) individuals are found in big numbers almost exclusively in the sections I and II.

About *Kurtus* the same can be said as about *Coilia,* viz. that either the young lives outside the fished area or that there is a definite spawning-time, which did not fall in January or October, the two months, when I visited Bagan Si Api Api. The smallest specimens I saw had a length of about 3—4 cm.

This species reaches maturity at a length of about 8,5—9 cm.

Fam. Sciaenidae.

89. **Sciaena vogleri** (BLKR.).

II. G.	III. E.
790 A few. Mature.	218 Rather abundant. Mature and immature.

Besides in the two places mentioned above, I did not find the species with any certainty. It is possible, that I overlooked some individuals in the catches of the jeremals, as most *Sciaena*-species resemble each other very much. I did not find any more specimens in the material collected and preserved of other jeremals. Yet I think it probable that this species can be found more, as in the catch of jeremal 218 it was rather abundant. I have no reason to suppose that the species lives only in that restricted region.

Sciaena vogleri reaches maturity at a length of about 10 cm.

90. **Sciaena albida** (C. V.).

II. G.
790 Rare. Mature and immature.
521 A few. Mature.

III. G.
602 A few. Immature.

III. E.
571 A few. Immature.

III. E.
104 A few. Immature.
72 A few. Immature.

This species may attain a length of a few dm and is caught in the jeremals as well as in the driftnets outside the jeremal-area. The young specimens, which I got, had a maximum length of about 10 cm.

91. **Sciaena belangeri** (C. V.).

II. H.
248 Rare. Mature.

III. I.
421 Rare. Mature.

III. E.
218 Rather abundant. Mature and immature.

I found this Sciaena species, which is very easily to distinguish, only in the three places mentioned above.

The distribution therefore is very scattered. One has to take in account the possibility, that *Sciaena belangeri* lives in shoals. Otherwise it cannot be explained why for instance in jeremal 218 the species is caught rather abundantly and why the other jeremals in the neighbourhood do not catch a single specimen. Perhaps this is also the reason for the scattered distribution of *Sciaena vogleri* (see above). It is very remarkable, that *Sciaena belangeri* as well as *Sc. vogleri* are found abundantly in the jeremal 218. I cannot say yet whether this is only accidental, or whether there is a special reason for it. I am quite sure, that *Sc. belangeri* occurs in the catches only from the places mentioned above, but I am not for *Sc. vogleri,* as was pointed out above (see *Sc. vogleri*).

The real limit of such a species is of course not easy to define as it will be found one day in this and the other day in another region.

The species reaches maturity at a length of about 10 cm.

92. **Sciaena glauca** Day.

I. E.
515 A few. Immature.
844 A few. Mature.

II. B.
X_3 A few.
778 Rare. Mature.

II. D.
173 Abundant. Mature.
259 A few.
315 A few.

II. E.
117 Rather abundant. Mature and immature.

II. F.
776 A few. Mature.

II. G.
790 Rare. Mature.

II. H.
809 A few.
521 A few. Mature.
248 Rare. Mature.

II I.
774 A few.

III. C.
546 A few.
86 Rather abundant. Mature.

III. D.
69 A few.

III. E.
787 A few. Mature.
218 Rare. Immature.
120 A few.

III. F.
559 A few.
171 Rather abundant. Mature and immature.

III. G.
652 A few. Mature.
X_1 A few.
202 Rare. Mature.

III. J.
Si Tsji Seneboei. A few.

IV. E.
520 A few. Mature.

IV. F.
104 A few.
389 Rather abundant. Mature.

IV. G.
153 Abundant. Mature
122 A few.
293 Rather abundant. Mature.

V. G.
592 Rare. Mature.

Sciaena glauca is the most common species of the genus. Everywhere, on the central bank as well as in the border areas, it is to be found rather regularly. *Sciaena glauca* is very euryhaline, as it is caught in the jeremals near the river-mouth proper as well as in the jeremals far out at sea. Nearly all specimens examined had ripe gonads and there is no evidence that the immature individuals live nearer to the coast, than the mature ones. Yet I sometimes found at a few places on the central bank and its nearest neighbourhood a single juvenile *Sciaena*, but I cannot say to which species it belongs. These specimens may belong to *Sc. glauca* as well as to any other species.

The number of the juvenile specimens, however, is very small and is out of proportion to the number of the ripe ones. The propagation of the various *Sciaena*-species therefore either seems to take place elsewhere or there is a definite spawning time, not coinciding with the months of January and October.

The great numbers of ripe individuals, which I found on each occasion, do not seem to confirm the last supposition. (See also *Kurtus, Coilia* and others).

This species reaches maturity at a length of about 8—9 cm.

93. **Sciaena carutta** (Bloch).

V. G.
592 A few.

I saw some individuals in the catch of jeremal 592 only.

94. **Sciaenoides pama** (Ham. Buch.).

III. G.	IV. F.	IV. G.	V. G.
652 A few. Immature.	389 A few.	195 A few.	592 A few.
602 A few. Immature.		253 A few.	

This *Sciaenoides* is the rarest of the four *Sciaenoides*-species occurring in the area. It is therefore the least important one.

I did not see a single mature specimen.

95. **Sciaenoides biauritus** (Cantor).

I. E.	I. H.	II. B.	II. D.
515 A few.	845 A few.	X_3 A few in October.	173 A few.
844 A few.			315 A few.

II. G.
658 A few. Mature and immature.
686 A few. Mature.
790 A few. Immature.

II. H.
248 Rather abundant. Immature.
809 A few.

II. I.	III. C.	III. E.
756 Rare.	86 Rather abundant. Mature.	218 Rather abundant. Mature.
774 A few. Mature.		

III. F.	III. G.	III. I.
103 A few. Mature.	X_1 A few.	421 A few. Mature.
	202 Rare. Mature.	

III. J.
Si Tsji Seneboei. Rare. Mature and immature.

IV. D.
676 A few. Immature.

IV. E.
520 A few. Mature and immature.

IV. F
310 Rather abundant. Mature.
104 A few.

IV. G.
153 Abundant. Mature.
195 Rare. Mature and immature.
293 A few.

V. G.
592 A few. Mature.

The fishermen do not distinguish this *Sciaenoides*-species from the members of the genus *Sciaena* and they are all called "Ikan goelamah". The following can

be said about the distribution. *Sciaenoides biauritus* is rare on the sandy bottom in front of Panipahan, but for the rest this very euryhaline species is found everywhere in the whole area, from the jeremals situated most seaward unto the jeremals situated near the rivermouth proper. There seem to be no special regions which the species prefers. All stages of maturity can be found everywhere.

Unlike *Sciaena glauca, Sciaenoides biauritus* does spawn inside the fished area. As a fact one can find each stage from young fishes of 1,5—2 cm up to mature individuals.

This young fry is found everywhere and does not seem to be restricted to one special region. Yet it is caught in greatest numbers on the central bank.

This species is mature at a length of 12—13 cm.

96. **Sciaenoides microdon** (BLKR.).

III. F.	IV. G.
171 1 specimen.	153 1 specimen.

In each of these two cases I got one single young specimen. The species is regularly caught by the driftnet fishermen. These specimens have a length of 4—5 dm and are mature. Also the outer jeremals may catch it sometimes. *Sciaenoides microdon* together with *Sciaenoides brunneus* and big *Sciaena*'s and *Silurids* are the fishes which furnish the so called fishstomach (= air bladder) of the trade.

97. **Sciaenoides brunneus** (DAY).

I. F.	II. H.
753 1 specimen.	248 1 specimen.
	809 1 specimen.

About this species the same can be said as about *Sciaenoides microdon*. People told me, that *Sc. brunneus* is less common than *Sc. microdon*.

I cannot confirm this from my own experience. The two species are found in front of other rivermouths too.

98. **Otolithus maculatus** (KUHL and v. HASS.).

II. D.	III. E.
259 1 specimen.	218 1 specimen.
	571 1 specimen.

In the area of Bagan Si Api Api this species is rare as is the case in other rivermouths.

Fam. Trichiuridae.

99. **Trichiurus glossodon** BLKR.

I. D.	I. E.	II. B.
781 A few. Immature.	844 A few. Immature.	778 Rather abundant. Mature.
	515 Rare. Immature.	

II. D.	II. E.	II. F.
173 Rare. Immature.	117 Rare. Immature.	567 A few. Immature.
II. G.	II. H.	
790 A few. Mature.	521 Rather abundant. Mostly immature.	
II. I	III. C.	
774 Rare. Mature and immature.	86 Rather abundant. Juvenile.	
III. E.	III. F.	III. G
218 Rare.Mature.	171 A Few.	602 A few. Immature
120 A few.		
787 Rather abundant. Mostly immature.		
III. I	IV. E.	IV. F.
Si Tsji Seneboei. Rare. Immature.	520 A few. Immature.	104 Very rare. Juvenile.

We conclude from the above data that *Trichiurus glossodon* is a rather common animal in the catches. It is found in the whole area on sandy as well as on muddy bottom. It is only on and about the central bank, that the species is absent. As a fact *Tr. glossodon* seems to avoid the relatively fresh and muddy water. I can not say much about the distribution of mature and immature animals. One may observe only that the percentage of mature animals increases in going seaward. Here Prof. DELSMAN found the planctonic eggs (see Treubia Vol. IX, 1926).

I did not find any young fry of the species. The smallest specimens had already a length of about 15 cm.

This species is mature at an approximate length of about 30—35 cm. As a fact the length of these fishes is not easy to be measured. The long pointed tail often varies in length as the end is often bitten of by other fishes. Of course this is the case with all species of *Trichiurus* (and *Coilia* also).

100. **Trichiurus savala** (C. V.).

I. D.	I. E.	I. F.
781 Rare. Immature.	844 A few. Immature.	753 A few. Mature.
	515 Abundant. Mature.	
II. B.	II. D.	II. E.
778 A few. Immature.	173 Rare. Immature.	117 Rather abundant. Mature and immature.
	315 Rare. Immature.	
	780 A few.	
	250 A few.	
II. F.		II. G.
567 A few. Immature.		686 A few. Immature.
776 Rare. Mature and immature.		658 A few. Immature.
		790 A few.

II. H.
248 Rare. Mature and immature.
521 Abundant. Mature and immature.
809 A few.

II. I.
774 Rare. Mature and immature.

III. C.
86 Rather abundant. Juvenile.
84 A few.

III. D.
68 A few.

III. E.
787 A few. Immature.
218 Rather abundant. Immature.

III. F.
559 A few. Immature.

III. G.
652 Rare. Juvenile.

IV. E.
520 A few. Immature.

IV. F.
310 A few. Immature.
104 Very rare. Juvenile.

V. G.
592 Rare. Juvenile.

This species is much more common than *Tr. glossodon.* The area of distribution is on the whole the same, only the young individuals are found much nearer the coast. (As far as jeremal 592, in front of the mouth of the Rokan!)

The mature specimens live in the area of the outer jeremals, as is to some degree, the case with *Tr. glossodon* also. The smallest specimens of this species had a length of about 15 cm. I did not see the young fry although Prof. DELSMAN found the eggs in the sea outside the outer jeremals.

This species is mature at an approximated length of about 35—40 cm and is therefore somewhat bigger than *Tr. glossodon.*

N.B. I found also some *Trichiurus* in the catches of the jeremals No. 676, 470, X_1, 845 and 253. As I did not preserve these specimens, I cannot say to which species they belong.

As all species of *Trichiurus* resemble each other very much, it is quite possible, that in the area of Bagan Si Api Api there can be found a third or even a fourth species which escaped my notice.

In examining the preserved animals at the laboratory I found only the two species, mentioned above. They are at any rate much more common than any other species, which eventually might be found at some time, or other.

Fam. Carangidae.

101. **Megalaspis cordyla** (L.) (*Caranx rottleri* BLKR.).

I. D.
781 A few. Juvenile.

I. E.
515 A few. Juvenile.
844 A few. Immature.

I. F.
753 A few. Immature.

II. B.
778 Abundant. Juvenile.
X_8 A few. Immature.

II. D.
315 Rare. Immature.
780 A few. Immature.

II. E.
117 A few. Immature.

II. G.
790 A few. Immature.

II. H.
404 A few.
521 A few. Immature.

II. I
774 A few.

III. C.
84 A few.

III. D.	IV. D	IV. F
69 A few.	X_2 Abundant. Immature.	310 A few.
68 A few.	676 A few. Immature.	

Most individuals of *Megalaspis* were very young animals with a length of 5—6 cm. I have called these specimens "Juvenile", bigger ones "Immature".

I never saw mature specimens, neither in the jeremals nor in the driftnets. The species is to be found on the sandy bottom in front of Panipahan as well as on the muddy bottom outside the central bank. On the central bank I found it only exceptionally in jeremal 310. The species is found therefore in the whole sections I and II and in the sections III. C, III. D, and IV. F, the same area of distribution as have so many species, which are absent on the central bank. It is noteworthy, that this species, which is so common near Bagan Si Api Api was found only very rarely by me in the mouths of other rivers of Sumatra and Borneo.

102. **Caranx (Atule) miyakamii** WAKIYA.

I. D.	V. G.
781 1 specimen. Immature.	592 A few. Immature.

This species must be euryhaline, as can be seen from the data given above. It seems to be very rare. I found also some young specimens in the mouth of the Indragiririver. I did not see a single ripe individual.

103. **Atropus atropus** (BLOCH SCHNEIDER) (*Caranx atropus*).

II. B.	II. H.	III. D.
778 A few. Juvenile.	248 A few. Immature.	69 A few.
X_3 A few.		
III. E.		
787 A few.		
218 A few. Immature.		

I did not see mature specimens of this species. As far as can be concluded from the few data, this species lives only in the western part of the area, as well on sandy as on muddy bottom. I found a few specimens also in other rivermouths.

104. **Alectis major** (C. V.) (*Caranx gallus* L.).

I saw only one dried specimen at Panipahan.

105. **Scomberoides lysan** (FORSK) ?

III. E.
218 A few. Juvenile.
120 A few. Juvenile.

I did not get mature specimens of *Scomberoides* in a fresh state, but I saw some in a dried state at Bagan Si Api Api. I got informations, that they are

caught sometimes in the outermost jeremals, but mostly by the driftnets. I am not sure that the young animals mentioned above really belong to *Scomberoides lysan*. It is therefore possible that another *Scomberoides* species may be found in the sea near Bagan Si Api Api.

106. **Platax** spec.

II. H.
248 1 specimen. Juvenile.

I could not determine the speciesname with certainty.

107. **Equula insidiatrix** (BLOCH).

II. B.	III. J.
X_3 1 specimen.	Si Tsji Seneboei. 1 specimen.

In each of these two cases I saw only one specimen. In the sea in front of the mouth of the Rokan this species is very rare. I found it much oftener in other rivermouths, together with other *Equula*-species, which seem to be totally absent in the Rokan mouth.

Fam. Stromateidae.

108. **Stromateus sinensis** EUPH.

II. D.	II. F.	III. C.	III. E.
780 1 specimen.	776 1 specimen.	546 1 specimen.	218 1 specimen.

I saw only a few young specimens of this rare species.

109. **Stromateus niger** BLOCH.

II. F.	III. C.	IV. F.
776 1 specimen.	86 1 specimen.	72 1 specimen.

Stromateus niger is in the sea near Bagan Si Api Api as rare as *Str. sinensis*. Sometimes a single specimen is caught which has gone astray, as *Str. niger* is a pelagic species of the open sea. This specimens, which I got were all young (± 10 cm). I saw one mature one in a dried state at Seneboei.

110. **Stromateus cinereus** BLOCH.

I. E.	I. F.	II. B.
515 Rare. Mature.	753 Rare. Mature.	X_3 Abundant. Mature.
844 Rare. Mature.		778 Abundant. Mature.
II. D.	II. F.	II. G.
173 Rare. Mature.	776 A few. Immature.	686 A few.
315 Rare. Mature.		790 A few. Immature.
780 Abundant. Mature.		
259 A few.		

II. H.
521 Rare. Immature.

II. I.
774 Rare. Immature.

III. C.
546 Abundant. Mature and immature.
86 Rare. Mostly immature.
84 A few. Immature.

III. D
68 Abundant. Mature and immature.

III. E.
787 A few.
218 Abundant. Immature.

III. F.
559 A few. Immature.

III. G.
602 1 specimen. Juvenile.

III. J.
Si Tsji. Some specimens. Juvenile.

IV. D.
X_2 A few. Mature and immature.
676 A few. Immature.

IV. F.
72 A few.
310 A few. Immature.

V. E.
470 A few. Immature.

Stromateus cinereus is very important for the fisheries and the catches of the jeremals on the sandy bottom near Panipahan contain this fish in a very high percentage. The species lives especially in the western part of the fished area. From the data given above it is evident, that the big numbers of ripe specimens are caught in the section I A - F, II A - D and III A - D. In the other sections a few stray, young animals only (Excepted jeremal 218, where they were caught abundantly) occurred in the catches and the more eastward the jeremals are situated the rarer and the smaller are the specimens taken.

The most eastern jeremals catch only a few individuals of a length of about 2—3 cm. On and about the central bank this species is absent. (Except jeremal 310! Why this jeremal shows so many exceptions in its catches I can not say).

Yet the young fry seem to live chiefly outside the fished area, as the small number of juvenile specimens is out of all proportion to the big number of mature fish. Also in front of Panipahan I only saw sporadically young specimens and fry was entirely absent.

It is also possible, that this species spawns chiefly in other months than January and October. Each year the bulk of the ripe fish disappears in July-August and comes back again in October-November. Several fishermen told me this and indeed during my visit during the first days of October I saw *Stromateus cinereus* in small quantities only and they were mostly immature. Whether this migration repeats itself every year and if so, how far the fish goes away, has to be ascertained by future investigations. Of course it is possible, that the fish moves slightly seaward only and so lives chiefly outside the fished area. Yet this supposition would not tally with the statement of the fishermen, who told me, that towards the end of the dry monsoon (August-September) the water has

a higher salinity as the river carries off less freshwater. As a logical consequence of this many species of fish can move more landward. *Stromateus cinereus* which requires a rather high salinity (25—30$^{0}/_{00}$) on the contrary migrates more seaward! (In the rainy monsoon the seawater of course will have a much lower salinity as the river carries down much freshwater and as a fact we see in that case that the bankfauna moves more seaward).

During my second visit in October it had just begun to rain and lasted for a fortnight and great masses of freshwater and mud were carried off into the sea.

In consequence of this, the situation as it was in the dry monsoon, had changed and yet *Stromateus cinereus* had not come back.

Therefore I suppose, in accordance with the facts, that the disappearance of *Stromateus cinereus* is due to some other reason than to a mere change in the salinity of the seawater, which would be opposed to the migrations of the species. What this other reason is, we can only guess now.

This species is mature at a length of 11—12 cm.

Fam. Scombridae.

111. **Scomber neglectus** V. KAMPEN.

Prof. DELSMAN found this species in a jeremal-catch from the area in front of Panipahan (collected by DE WAART 1922). I did not see this species myself.

112. **Cybium kühli** C. V.

I. F.
753 1 specimen. Mature.

II. B.
778 1 specimen. Mature.
X_3 A few. Immature.

II. F.
776 A few. Immature.

II. G.
790 A few. Immature.

II. H.
248 1 specimen. Immature.
521 A few. Immature.

II. I.
779 A few. Immature.

III. C.
84 Rare. Immature.

III. E.
571 A few. Immature.
218 A few. Immature.

Cybium kühli is a Cybiumspecies, which is often found in the rivermouths. It is the most common of the three species found near Bagan Si Api Api.

Mostly young specimens of a length of 10—15 cm are caught and only in the outermost jeremals and in the driftnets a mature specimen is sometimes found. As a rule one can find in a single catch not more than two or three specimens. Jeremal 84 was an exception as I found here 40—50 specimens.

The area of distribution of *Cybium kühli* is situated outside the central bank.

In other rivermouths (Panei, Indragiri), which do not carry such quantities of mud, *Cybium kühli* is found much further inland. The salinity seems to determine the limit of the presence of the species there, whereas in front of the Rokan river this limit is determined by the percentage of mud.

113. **Cybium guttatum** BL. SCHN.

I. E.	II. B.	II. D.
515 1 specimen. Immature.	778 1 specimen. Immature.	780 1 specimen. Immature.
	X_3 1 specimen. Immature.	

II. F.	II. G.
567 A few. Immature.	686 1 specimen. Immature.
776 1 specimen. Immature.	

III. D.	III. I.
68 A few. Immature.	421 1 specimen. Immature.

The distribution is about the same as of *Cybium kühli* but *C. guttatum* is less common than the former. I did not see a single mature specimen, but it is possible that the outermost jeremals and the driftnets sometimes take one.

114. **Cybium lineolatum** C. V.

III. E.
218 1 specimen. Immature.

I saw only this single specimen.

115. **Echeneis naucrates** L.

III. D.
68 1 specimen.

I did not get more than this single specimen.

Fam. C o t t i d a e.

116. **Platycephalus insidiator** (FORSK.).

I saw one mature specimen at Seneboei. This species seems to be very rare, as the fishermen did not know it.

Fam. G o b i i d a e.

117. **Gobius** spec.

III. I.
421 1 specimen.

I saw only one specimen of this species, the name of which I could not determine.

118. **Apocryptus lanceolatus** (BL. SCHN.).

III. G.
602.

I saw only one specimen of this species.

119. **Periophthalmus chrysospylos** BLKR.

I preserved only one specimen caught in jeremal X_1.

I saw several times in other jeremalcatches a single dead specimen (see

above). I neglected to preserve these specimens and also I omitted to note down their occurrence, as of course they do not belong to the regular fishfauna of the area of that special jeremal. As I did not collect any specimen at the coast, I cannot say whether *Periophthalmus chrysospylos* is the only species of the genus at Bagan Si Api Api.

120. **Eleotris** spec.

II. H.
180 1 specimen.

I could not determine the name of this specimen.

121. **Eleotris** spec.

III. E.
787 1 specimen.

III. J.
Si Tsji Seneboei. 1 specimen.

Of this species also, it was impossible for me to determine the species name.

122. **Gobioides anguillaris** L.

II. D.
315 1 specimen.
173 A few in October.

II. G.
686 Rather rare. Mature.
790 Very rare. Mature.

II. H.
248 1 specimen. Mature.

II. I.
774 A few.

III. C.
86 A few. Juvenile.

III. E.
571 A few.

III. F.
171 A few.
901 Rare (in October).
559 Rare (only at high tides).

III. G.
X_1 Abundant.
652 Rare. Mostly immature.
602 In January a few. In October abundant.
202 Abundant. Mature and immature.

III. J.
Si Tsji Seneboei.

IV. F.
Boeboes Halang. A few.
389 Abundant. Mature and immature.
72 Rather abundant. Mature and immature.
310 Rather abundant. Mature and immature.

IV. G.
293 Abundant. Mature and immature.
195 Rare. Mature.
122 Abundant. Mature and immature.
298 „ „ „ „
402 A few. Immature.
253 Abundant. Mature and immature.
153 „ „ „ „

V. E.
438 Rather abundant in October. None in January. Mature and immature.
470 „ „ „ „ „ „ „ „ „ „

V. F.
413 Rather abundant.

V. G.
592 Very abundant. Mostly juvenile.
729 „ „ „ „

Gobioides is a very important component of the fauna and in some cases it constitutes even 75—80% of the catches.

For human consumption the species is not much esteemed and the catches are for the greater part used as pigfood. *Gobioides* is a typical muddwelling animal, which prefers therefore the parts of the sea with a soft muddy bottom. The animals seem to hide in the mud at low tide, as in the jeremals situated on the part of the central bank, falling dry at ebbtide, one can catch specimens of *Gobioides* in great numbers until the last moment. The very minute eyes are in accordance with the burrowing mode of life. Of course there are also animals, which are dragged away with the tide. This is proved by the fact, that the jeremals farther out at sea, catch more *Gobioides* at the end of the tide, than at the beginning of it. (See the record of jeremal 218 p. 122). Thus for instance *Gobioides* is caught in jeremal 559 at very high tides only when the currents are very strong.

At least I did not see any *Gobioides* there at neaptide whereas a fortnight later, at high tide, there were a few specimens in the catch. The fishermen told me, that this was always the case. I think that the same thing happens in other jeremals in that region. As I had no time to visit them all twice, I cannot say now if this supposition is true.

Gobioides is distributed over the whole fished area, the part with sandy bottom in front of Panipahan excepted. As the jeremals are situated more seaward, *Gobioides* occurs rarer in the catches.

In the whole section I did not see a single specimen and the fishermen of jeremal 844 told me, that *Gobioides* was exceptionally rare in their area.

The region where the species lives in big numbers is the central bank. In this case inside a line, which can be drawn from the southpoint of Pulu Halang Bĕsar to a place north of jeremal 72 and from there over jeremal 202 to the maincoast.

Inside this region *Gobioides* obviously prefers the eastern part near the maincoast of Bagan Si Api Api.

It is to be regretted that in the middle part of the bank there are only very few jeremals. This part is reserved for the shrimpfisheries. It is therefore not possible to discover if the occurrence of *Gobioides* in a western direction becomes gradually more sporadic. One would expect this, as the jeremals near jeremal 72 (section IV F) did not catch the species, when I visited them, whereas jeremal 72 itself caught many of them. Jeremal 298, in the centre of the bank, caught *Gobioides* abundantly.

In October, when the river carried down large quantities of mud and, as a consequence the surface of the bank had increased considerably, the area in which *Gobioides* was abundant had increased also. To the north the boundary line had to be drawn now over jeremal 602 (III G) in stead of over jeremal 202. Accordingly I found in jeremal 901 (III F) some *Gobioides,* which did not occur in January.

Between Pulu Halang Bĕsar and the main coast, where in January I found

a few individuals only, I found them in October in rather great numbers. The area in which *Gobioides* is common has been therefore enlarged in several directions. I got information, that this is the case every year. After some time the extension of the central bank decreases again through the influence of the tides, so that the central bank returned to its old shape. (Of course the central bank, consisting of such soft material is altering continuously its shape, which therefore never has a fixed outline).

In the area of the central bank one can find individuals of *Gobioides* of all lengths. In almost every jeremalcatch one can find also very young individuals (fry) and in the jeremal 529 and 729 (V G) the fry even preponderates.

As I cannot distinguish the fry of the different species of *Gobioides* it seems to me superfluous to give a special list of the places where I found them. After all in nearly every jeremal, which catches the mature *Gobioides* in any considerable number young fry is found also.

This species is mature at a length of about 11—12 cm.

123. **Gobioides cirratus** (BLYTH).

II. D.	II. E.	II. G.
173 A few (October).	117 Rare. Mature.	562 Very rare. Mostly immature.
315 A few.		602 Abundant (in October).
		X_1 Abundant.
		202 Abundant. Mature and immature.

III. J.	IV. E.	IV. F.
Si Tsji Seneboei.	510 Rare. Mature.	72 Rather abundant. Mature.
		310 Rare. Mature and immature.
		389 A few.

IV. G.	V. E.
293 Abundant. Mature and immature.	470 A few in January. Rather abundant in October.
195 Rare. Mature and immature.	
122 Abundant. Mature and immature.	438 Rather abundant in October.
402 Rare. Immature.	
153 Abundant. Mature and immature.	
253 Abundant. Mature and immature.	

V. F.	V. G.
413 Rather abundant. Mature and immature.	592 Rare.
	729 Rare. Mature and immature.

Gobioides cirratus is just as common as *G. anguillaris* and their areas of distribution are about the same.

Where one species is to be found, one can find the other also.

A discussion of the area of distribution of *G. cirratus* and of other particulars is superfluous as in every respect they quite agree with those of *G. anguillaris*.

This species is mature at a length of about 15 cm.

124. **Gobioides rubicundus** (HAM. BUCH.).

II. G.
686 Rare. Mature and immature.

III. G.
562 A few.
X_1 Rare. Mature.
602 A few. Immature.

IV. F.
104 A few.
310 A few.

V. G.
On the roadstead of Bagan in a planctonnet.
729 ? Juvenile.

Gobioides rubicundus seems to inhabit the same area as the two species mentioned above, but it is much rarer. This species may be easily distinguished from the other ones by its short and thick shape and the russet colour. Perhaps I saw young fry for the species in jeremal 729.

This species is mature at a length of about 15 cm.

125. **Gobioides tenuis** (C. V.). ?

IV. E.
520 1 specimen.

I saw only this single specimen. I am not certain of the name.

N.B. I suppose that more species of *Gobioides* will be found if a thorough search is made for them in the catches. All species (except *G. rubicundus*) resemble each other so much that they are not easy to distinguish if one examines them superficially, when the catch is spread out on the deck. It is certain however, that these other species if any must be rare.

126. **Trypauchen vagina** (BL. SCHN.).

II. G.
686 A few.

II. H.
248 1 specimen.
521 1 specimen.

III. D.
68 1 specimen.

III. E.
571 A few.

III. G.
X_1 A few.

III. H.
414 1 specimen.

III. I.
421 1 specimen.

III. J.
Si Tsji Seneboei. A few.

Trypauchen vagina is sporadically found in the area with a muddy bottom outside the central bank. This species thus avoids the area where *Gobioides* is common. It is also absent in the area with a sandy bottom and in the area of the outermost jeremals. I did not see a single specimen in the whole section I. At any rate this species is not common. I saw never more than a few specimens in one catch.

127. **Trypauchen microcephalus** BLKR.

III. J.
Si Tsji Seneboei. A few.

This is the only place where I found a few specimens of this very rare species.

128. **Trypauchenichthys sumatrensis.** Nov. spec. [1]).

III. G.
652 3 specimens.

This is the only place where I found this species.

129. **Pseudotrypauchen multiradiatus.** Nov. spec. [1]).

III. G.
602.

Besides the specimen from the catch of jeremal 602 I found a few in the collection DE WAART. (1922).

Fam. Sclerodermi.

130. **Triacanthus breviostris** TEMM. and SCHLEGEL.

II. B.
X_3 1 specimen.

I saw this single specimen only.

Fam. Gymnodontes.

131. **Xenopterus naritus** RICHARDSON.

II. H.	III. E.	III. G.	IV. D.
248 1 specimen.	218 2 specimens.	562 1 specimen.	676 1 specimen.
		602 1 specimen.	

All species of this family are very rare, except *Xenopterus naritus,* which is the most common of them. I found a few scattered specimens. The number of the places, where they were collected, is too small to draw any conclusion regarding the area of distribution.

At any rate it seems that the central bank is avoided.

132. **Tetrodon oblongus** (BLOCH).

III. G.
602.

I saw only one specimen.

133. **Tetrodon fluviatilis** HAM. BUCH.

III. J.
Si Tsji Seneboei. A few small specimens.

This species, which is so common in front of other rivermouths seems to be very rare in the sea near Bagan Si Api Api.

134. **Tetrodon lunaris** BL. SCHN.

II. B.
X_3.

I saw one specimen only.

[1]) A description of this new species will be published in a short time.

Fam. Carchariidae.

135. **Carcharias laticaudus** MÜLL. HENLE.

II. H.
521.

I saw one specimen only.

136. **Carcharias temminckii** MÜLL. HENLE.

I. E	II. D.
515 1 specimen.	780 1 specimen.

Nothing particular can be said about this species.

137. **Carcharias limbatus** MÜLL. HENLE.

III. F.
171.

I saw one specimen only.

138. **Carcharias mülleri** MÜLL. HENLE.

I. D.	I. E.	II. D.	II. E.
781 1 specimen.	515 A few.	259 A few.	117 A few.
	844 A few.	780 1 specimen.	
II. G.	III. C.	III. E.	IV. D.
658 A few.	86 1 specimen.	218 A few.	676 A few
790 A few.			
689 A few.			

Carcharias mülleri prefers the Eastern Border Area. This species is often caught with the hook and also in the driftnets.

Besides, for the jeremals mentioned above, I noted a *Carcharias*-species in the jeremals 470, 652, 171, 571, 809 and 845, of which I did not determine the speciesname. Most probably they belong to *Carcharias mülleri,* which is by far the most common species.

Fam. Scylliidae.

139. **Stegostoma tigrinum** (GMEL.).

IV. G.
195 A few.

This species seems to be very rare. They brought me the animals as a great curiosity.

140. **Chyloscyllium indicum** (GMEL.).

I. F.	II. G.	II. H.	III. F.
753 1 specimen.	658 1 specimen.	248 1 specimen.	171 1 specimen.

This species is only found sporadically.

From the places mentioned above it follows, that the sharks prefer the borderareas. Yet they are caught sometimes on the central bank and I am told that they are caught in the river as far as 40 miles upstream. I do not know to which species this refers. I did not get a single fresh specimen. I saw on several jeremals on the central bank (f.i. No. 592) small specimens caught on previous days and already salted. The fins had always been cut off, but judging from the shape of the head, they belonged at least for the greater part to the genus *Carcharias*.

Fam. Pristidae.

141. **Pristis** spec.

I saw at Seneboei the saw of a young animal. I could not determine the speciesname. The specimen had been caught in one of the jeremals in the neighbourhood.

Fam. Rhinobatidae.

142. **Rhynchobatis djeddensis** (FORSK.).

III. C.
86 1 specimen.

I saw one specimen only.

143. **Rhinobatis halavi** (FORSK.).

I.F.	III. E.
753 1 specimen.	571 1 specimen.

A rare species.

Fam. Trygonidae.

144. **Trygon sephen** (FORSK.).

II. G.	IV. D.
686 1 specimen.	676 1 specimen.

A rare species.

145. **Trygon uarnak** (FORSK.).

III. H.
248 1 specimen.

I saw this single specimen only.

146. **Trygon walga** MÜLL. HENLE.

II. D.	II. G.	II. H.
780 1 specimen.	686 1 specimen.	571 A few specimens.
III. C.	III. E.	III. F.
546 1 specimen.	218 1 specimen.	171 1 specimen.
86 A few specimens.	571 1 specimen.	
III. G.	III. I.	III. J.
X_1 1 specimen.	421 A few specimens.	Si Tsji Seneboei. A few specimens.

IV. F. V. E.
72 1 specimen. 470 1 specimen.

Trygon walga is the most common ray and most preserved rayskins, sold on the market, are skins of this species. I was told, that they are sometimes caught on the central bank, but they never seem to ascend the river.

147. **Pteroplatea micrura** (BL. SCHN.).

II. B. II. H.
778 1 specimen. 248 1 specimen.

A rare species.

Fam. M y l i o b a t i d a e.

148. **Myliobatis maculata** GRAY and HARDW.

I. D. II. G.
781 1 specimen. 658 1 specimen.

A rare species.

149. **Aetobatis narirari** (EUPH.).

II. B.
778 1 specimen.

I saw this single specimen only.

In examining the list of species given above, it appears, that the fishfauna of the sea near Bagan Si Api Api is composed of a restricted number of families only.

In the first place the family of the *Clupeidae* must be mentioned. Its members live chiefly in the two borderareas. Species, represented by a great number of individuals, have their fry in the area of the central bank. To this group belong *Setipinna taty* and *breviceps, Engraulis kammalensis, Stolephorus baganensis* and *Raconda russelliana.* This species belong to that group of fishes, of which I said on page 97, that the mature animals live in the borderarea and the young fry nearer to the coast on the central bank. Every stage of their life is spent within the fished area. Of *Coilia dussumieri,* though occurring in big numbers, I have not yet found the fry.

Besides the ones mentioned above we can find in the borderareas other species in smaller numbers, which do not pass their whole life within the fished area.

These are partly occasional guests as *Engraulis mystax* and *grayi, Clupeoides lile* and others, and partly species, which are typical for the fished area, but which are by no means common. To the latter group belongs for instance *Chirocentrus hypselosoma,* which spawns just outside the fished area and of which young specimens are caught in the borderarea together which some mature ones. *Pellona*-species also are be reckoned among these. These species show the coastward migration of the young specimens very clearly as the fry lives on the

central bank, the young individuals in the border areas and the mature ones mostly outside the fished area. *Dorosoma chacunda* is also regularly found in small numbers, but seems to spawn outside the fished area, as I never found any young fry.

The *Scopelidae* are represented by a single species only, *Harpodon nehereus*. Of this species too, the young specimens live nearer to the coast than the mature ones.

The order of the *Silurids* shows many species, but none of these species is common and most of them are very rare. This group therefore has no influence on the composition of the fauna. Most specimens are caught on the central bank.

They belong for the greater part to species, which are very euryhaline. As a fact many of them live in the river in fresh water and some specimens descend into the more saline waters on the central bank. Others as for instance the species of the genera *Osteogeneiosus* and *Arius* may live in fresh as well as in salt water.

The *Cyprinids* are represented by a few species only, all of which are very rare. They live in the fresh water of the river and sometimes a few specimens descends into the brackish water. They are found only in that part of the central bank, which is situated quite close to the rivermouth. They are of absolutely no importance for the composition of the fauna.

The eels also are not very important. The most common is *Muraenesox talabon*, which lives in the Western Border Area.

I can say nothing in particular of the *Belonidae* and *Hemirhamphidae*, *Hemirhamphus georgii* is the most common. This species is absent in the Central Area.

The *Polynemidae* are very important. *Eleutheronema tetradactylum* is the most common species. I saw only young specimens. They are found in big numbers in the Central and Western Border Area. Mature animals live chiefly outside the jeremal area. The same is the case with *Polynemus indicus*, but immature specimens of the latter species are seldom caught. Mature individuals of the two species are often taken by the driftnet fishermen.

Polynemus dubius seems to be a freshwater species sometimes descending into the sea.

A sandy bottom is more or less avoided by all species found near Bagan Si Api Api.

The three species of the *Mugilidae* are of little importance. *Mugil dussumieri* seems to be very euryhaline. Specimens of freshwater *Mugils* are occasionally found on the central bank.

The order of the *Heterosomata* is represented by a few species of the family of the *Soleidae* only. Only one of them, *Cynoglossus monopus* is common and this species is a very important component of the fishfauna. In some places it is even predominant. It is one of the typical species of the Central Area.

The *Percidae* (sensu latu) are very rare off Bagan Si Api Api. A few species are present. I found only a few specimens of each. Even a genus with

so many species as *Ambassis* is totally absent, though they are common in other rivermouths.

I cannot give a sound reason for this fact.

The small family of the *Kurtidae* is represented by one species, *Kurtus indicus,* which is typical for the whole fished area and which is caught everywhere in great numbers. I found *Kurtus* regularly in front of other rivers, but never in such large quantities.

The *Sciaenids* are represented by many species and in great numbers. They are caught everywhere, but seem to prefer a muddy bottom. This group is very important for the fisheries. Small individuals of the different genera and species are called "Ikan goelamah" by the fishermen. They are as all other fishes exported in a dried and salted state. The so called „Fishstomach" is made of the airbladder of the bigger specimens.

Two species of *Trichiuridae* are found and each of them is very common. *Trichiurus glossodon* goes further in the brackish water than *Trichiurus savala.*

Carangids are rare and they are chiefly found in the borderareas, in an immature or juvenile stage. The mature specimens live outside the fishing area. *Megalaspis cordyla* is the most common species. It is noteworthy that species of the genus *Equula,* so common elsewhere are practically absent here. I do not know the reason for this.

Stromateus cinereus is the most important species of the *Stromateidae.* It lives in the Western Border Area and in the western half of the Eastern Border Area.

This species seems to migrate at definite times out of the areas mentioned above. The two other *Stromateus*species are of no importance.

The *Scombridae* are represented by a few species of which only *Cybium kühlii* and *guttatum* are of some importance. Nearly all specimens caught in the jeremals are immature, so that these species as a matter of fact live outside the fished area, and only the young specimens, which live near to the coast are caught sometimes.

The *Gobiids* are in some places very important. They prefer the areas with a muddy bottom and especially on the central bank species of *Gobioides* are very common. Species of other *Gobiid*genera are very rare. The rich genus *Gobius* for instance is represented by two species only.

The *Gymnodonts* are rare. *Xenopterus naritus* is the most typical representant of them. *Tetrodon fluviatilis,* elsewhere common in regions like this, is very rare for unknown reasons.

Several families of the *Plagiostomata* are found. The *Carchariidae* with *Carcharias mülleri* and the *Trygonidae* with *Trygon walga* are the most common of them. Yet this group is not important for the fauna as most species are very rare.

It results from what has been said above, that the fishes which form the bulk of the catches, and which are therefore the most important for the fisheries, pass their whole life-cycle inside the fished area.

As these species do not live outside the estuaries in nearly such big numbers or are absent at all (judging from the catches of the fishermen along several points of the coast), is is obvious that the fisheries in the Rokan-mouth depend for the greater part on this special estuarine fauna.

People of Bagan are often inclined to assume a continuous immigration of fish from Malacca Strait into the estuary of the Rokan. If this were right, then, of course, there would be little danger of over-fishing. We have seen, however, that this fresh supply from outside the area cannot be very important.

The species which pass their whole life-cycle inside the fished area, are *Setipinna breviceps* and *taty, Engraulis kammalensis, Stolephorus baganensis, Raconda russelliana, Harpodon nehereus* (for the greater part), *Cynoglossus monopus* and species of *Gobioides*. Species as *Sciaena glauca, Sciaenoides biauritus* and *Stromateus cinereus* belong to also to a certain degree to this group, as they spawn, partly at least, in the fished area.

It is very probable, but not absolutely certain, that *Coilia dussumieri* and *Kurtus indicus,* belong to this group also, as their planctonic eggs have been found, but not the young fry.

Only one species, economically important, forms an exception, viz. *Eleutheronema tetradactylum,* of which only young individuals are found. Spawning takes place outside the fished area, as mature specimens are only caught sometimes at its borders.

IX. REVIEW OF THE DIFFERENT REGIONS.

If we consider now the distribution of the fishfauna over the different regions, we come to the following results.

I. THE CENTRAL AREA.

In the Central Area we find as typical (i.e. to be found in almost all catches) the following species:

1. The species of the genus *Gobioides*, ***Gobioides anguillaris, cirratus*** and the less common *rubicundus*. The related *Trypauchen vagina* is absent here.
2. ***Harpodon nehereus,*** mainly immature specimens.
3. ***Eleutheronema tetradactylum***, only young specimens.
4. ***Cynoglossus monopus,*** which is rare outside the central area. All stages are found regularly (perhaps the rare *Cryptops caeca* should be mentioned here also).
5. ***Kurtus indicus***, mostly young individuals only. This species is common in the two other areas too.
6. *Sciaena glauca,* mature as well as immature.

This species is common outside the central area too.

7. *Sciaenoides biauritus*. The same can be said here as about *Sciaena glauca.*

Besides those mentioned above we find here some species descending from the river and which are all rather rare.

In th first place we must mention here several *Silurids,* e.g.

1. *Cryptopterus hexapterus.*
2. *Pangasius nasutus.*
3. *Pangasius polyuranodon.*
5. *Ketengus typus.*
6. *Hemipimelodus macrocephalus.*
7. *Macrones wolffi.*
8. *Macrones nemurus.*
9. *Macrones micracanthus.*

In the second place, we must count among the species descending from the river the Cyprinidspecies. They are all very rare, e.g.

1. *Rasbora argyrotaenia.*
2. *Leptobarbus hoevenii.*
3. *Osteochilus melanopleura.*

WEBER and DE BEAUFORT further mention for Bagan Si Api Api the freshwater species *Osteochilus spilurus* and *Puntius hexazona* and the two *Anabantids* and also *Setipinna breviceps.* The exact place where they had been caught is unknown to me.

The Central Area is also a region where the fry of several species is found. In the first place there is the fry of *Gobioides,* which passes its whole life-cycle within the Central Area, and also of *Cynoglossus monopus* and *Harpodon nehereus,* which have their life-cycle partly outside the Central Area, but within the whole jeremal-area. In the second place the fry of some species from the Eastern Border Area is found. Among these we must count chiefly the following species.

1. *Setipinna breviceps.*
2. *Setipinna taty.*
3. *Engraulis kammalensis.*
4. *Stolephorus baganensis.*
5. *Pellona* spec.
6. *Sciaena* spec. (Rare).
7. *Sciaenoides biauritus.* (This species has its fry in the other areas also).

Sometimes specimens are caught in the Central Area, belonging to fishes which live in the borderareas e.g. species of *Setipinna, Engraulis, Trichiurus, Caranx* and so on.

Sergestes and several species of shrimps are caught in great quantities in the Central Area.

I think, I have sufficiently characterized the fauna of the Central Area by the data given above.

As I have already pointed out (page 98) it is difficult to determine the limits of an area very exactly. The occurrence of *Harpodon nehereus, Kurtus indicus, Sciaena glauca* and *Sciaenoides biauritus* cannot be used, when we wish to give the exact boundary line, as these species are caught in the borderareas

also in large quantities. These species, though they are to be found in each catch, are by no means typical for the Central Area.

Of the remaining species, which I have given above as abundant in the Central Area, we will consider *Eleutheronema tetradactylum* and *Cynoglossus monopus* first. These two species have about the same area of distribution. If we take into consideration those sections only where they are abundant and leave out the sections where they are rare, then we see, that they are numerous in the sections III G, IV F and V E on the central bank and in the section III E and F northwest of the bank. In these latter sections, however, *Eleutheronema* and *Cynoglossus* are caught together with *Setipinna taty* and other species not occurring on the central bank.

The composition of the catches is here quite different from those on the central bank. Thus *Engraulis kammalensis* is found abundantly in section III. F, in section III E *Setipinna taty* also.

Therefore the occurrence of *Eleutheronema* and *Cynoglossus* does not afford a reliable criterion for the boundary of the Central Area.

Gobioides is found abundantly in the sections III. G, IV. F and V G and not in the sections III. E and F.

The limit of the abundant occurrence can be drawn from the coast to jeremal 202 and along jeremal X_1 to 72 and from here south of Pulu Halang Běsar to the coast opposite the island. This is the boundary in January.

In October the border of the central bank has moved further seaward. Then the limit of abundant occurrence has moved also and may be traced now from jeremal 602 to 901 and to a point somewhat north of jeremal 72 and from here to Pulu Halang Běsar, the southern half of the latter now lies within the area of *Gobioides,* as on the other side of the island the line can be drawn to the maincoast along jeremal 470. I should like to take the lines indicated above as the limits of the Central Area. Within these limits only, the composition of the fauna is characteristic. These limit lines thus may move 2 à 3 seamiles according to the seasons.

Further the area is limited by the coast. I can not indicate the exact boundary line in the rivermouth proper, but it must be somewhere near Pulu Pěrdamaran.

II. THE EASTERN BORDER AREA.

The Eastern Border Area is the most extensive of the three areas and it is the most important for the fisheries.

We find as typical species:

1. *Chirocentrus hypselosoma.*
2. *Dorosoma chacunda.*
3. *Setipinna breviceps.*
4. *Setipinna taty.*
5. *Engraulis kammalensis.*
6. *Engraulis dussumierii.*

7. ***Stolephorus baganensis.***
8. *Coilia dussumierii.*
9. *Pellona* spec.
10. *Raconda russelliana.*
11. ***Harpodon nehereus.***
12. *Hemirhamphus georgii.*
13. *Eleutheronema tetradactylum.* This species is found regularly in smaller numbers, but only in the section III E and F abundantly.
14. *Cynoglossus monopus.* See Eleutheronema.
16. ***Kurtus indicus.***
15. ***Sciaena glauca.***
17. ***Sciaenoides biauritus.***
18. ***Trichiurus glossodon.***
19. ***Trichiurus savala.***
20. *Stromateus cinereus.* This species is found in the western half of the area only and is as a fact the typical species of the Western Border Area.

Only the names printed in bold type refer to species which are found regularly in almost every catch though the other ones are common too.

Furthermore we can find in the Eastern Border Area a great number of less common species, not mentioned above. These are on the one side species typical for the Central Area, as for instance *Gobioides,* and on the other side species from the open sea, as for instance *Polynemus indicus, Pristipoma guoraca, Sphyraena* spec., *Sciaenoides brunneus, Stromateus niger,* several species of the *Plagiostomata* and adult specimens of *Cybium* and *Chorinemus.*

A third group of fishes must be mentioned here for this area, viz. those species, which live always near the coast but do not prefer especially the rivermouths. The most important seem to me to be:

1. *Engraulis dussumierii, grayi* and *mystax.*
2. *Stolephorus tri.*
3. *Clupeoides lile.*
4. *Clupea toli* and *macrura* (also found in the Central Area).
5. *Plotosus canius.*
6. *Osteogeneiosus militaris.*
7. *Muraenesox cinereus* and *talabon.*
8. *Tylosurus strongylurus.*
9. *Hemirhamphus georgii* and *gaimardi.*
10. *Mugil dussumierii.*
11. *Cynoglossus lingua.*
12. *Therapon theraps.*
13. *Scatophagus argus.*
14. *Sciaena belangeri, albida* and others.
15. *Otolithus maculatus.*
16. *Trypauchen vagina.*
17. *Xenopterus naritus.*

18. *Carcharias mülleri* and others.
19. *Trygon walga.*

and a few rare species, not mentioned here.

Young individuals of species living in the open sea are found also in this area. In the first place I mention as belonging to this group, *Eleutheronema tetradactylum* (see also above) and several *Carangids* and *Scomberids,* of which *Megalaspis cordyla* (*Caranx rottleri*) and *Cybium kühlii* and *guttatum* are the most common, together with species like *Clupea toli* and *macrura, Sciaenoides microdon* and *brunneus.*

The following can be said about the limits of the Eastern Border Area. On the northwestern and northeastern side the line coincides with that of the jeremalarea (see chart). Perhaps this area reaches farther seaward, but I do not possess any data relating to that part of the sea, as there are no jeremals there. On the south side the Eastern Border Area is limited by the coast near Seneboei, by the Central Area and by the coast opposite Pulu Halang Bĕsar. This island is situated wholly or only partly within the Eastern Border Area, according to the seasons (see the limits of the Central Area given above). As the boundary line between this and the Western Border Area I take the line indicating the western limit of the abundant occurrence of *Setipinna taty.* This species is so common in this area (except in III F), that I take it for the most characteristic fish. This western limit must be drawn on the chart from the bend of the line of the jeremalarea along jeremal 546 (south of it) to the coast.

In the Eastern Border Area the components of the fauna are not always the same. One or more components may be absent in the catches. Thus I pointed out already that *Setipinna taty* is rare in section III F and that *Engraulis kammalensis* is rare in II C and D and IV F. *Stromateus cinereus* is found in the western part of the area only and *Trypauchen vagina* in the eastern half only. *Coilia dussumierii* is as a matter of fact common in the whole section I and II and it is rather rare in the whole section III. More examples of this kind may be given, but I think these are sufficient.

I do not believe, that too much stress may be laid on these differences and I have treated therefore the Eastern Border Area as one entity and I have not split it up into smaller areas. In that case separate area ought to be made for about every species. These areas would overlap each other for the greater part. It is after all, not one species, but a combination of species, which determines the fauna of a given region. The modifications from common to totally absent are slight and gradual. Therefore it is not easy to make out in what case a species is just common enough or just not common enough to be considered as a characteristic component of some given area.

III. THE WESTERN BORDER AREA.

The Western Border Area is the smallest and the least important for the fisheries. It has a relatively small number of species.

I give as characteristic species:

1. *Stolephorus baganensis.*
2. ***Kurtus indicus.***
3. *Trichiurus glossodon.*
4. *Trichiurus muticus.*
5. ***Stromateus cinereus.***

The names printed in bold type refer to the most important species. Besides the species mentioned above, I found regularly in small numbers.

1. *Coilia dussumierii.*
2. *Hemirhamphus georgii.*
3. *Eleutheronema tetradactylum.*
4. *Sciaena glauca.*
5. *Sciaenoides biauritus.*

Besides these we find from time to time the young individuals of the following species, of which the adults live further out in the sea.

1. *Clupea toli.*
2. *Megalaspis cordyla* (*Caranx rottleri*).
3. *Cybium kühli* and *guttatum.*

As a matter of fact *Eleutheronema tetradactylum* belongs to this group also. But it is found so regularly that I put it in the second group.

The Western Border Area is characterised sufficiently by the species mentioned above.

It is easy now to trace the border line of the Western Border Area. It is limited by the Eastern Border Area (see above), by the coast of Panipahan and seaward by the limits of jeremal area.

This latter limit is of course only artificial. It would be situated probably more seaward if more jeremals were found in that part of the sea. I do not know how far the Western Border Area actually reaches in the directions of the sea, as I have no data of the region outside the jeremalarea. However, it cannot be very far as in that case we get in the deep water of the open sea as the bottom slopes fairly steeply here. Neither can I say precisely, how the limit between the Western and Eastern Border Area changes according to the different circumstances in the rainy and the dry monsoon.

That there are seasonal changes is beyond doubt and these changes will coincide with the changes in the boundary line between the Central- and the Eastern Border Area (see above). The water in the estuary becomes less salt and more muddy when the river carries down much fresh water into the sea and the influence of this will extend into the Western Border Area also.

I do not know how far this Western Border Area extends in a north-western direction along the coast. I did not visit any jeremal beyond Panipahan (from Bagan Si Api Api), as these were too far away from the base.

The fished area extends in a northwestern direction as a narrow stretch along the coast and into the mouth of the Panei river. In the mouth of that

river the fauna is different and therefore there must be somewhere a more or less marked transition.

X. FOOD OF THE FISHES.

From all what has been said above it follows, that a few families only are important as components of the fauna. These families have not only the majority in the number of genera and species, but also in the number of individuals. They are the most important for the fisheries. These species or groups of species obviously are best adapted to the circumstances characteristic of a rivermouth.

In comparing this fauna with the fauna of other estuaries one is struck immediately by the fact, that some important components of the Bagan fauna are absent in the latter and are replaced by others. I do not know what may be the reason for this, but it is evident, that the explanation may be partly found in the chemical composition of the water carried down by the river. This water seems to have in our case components which favour a rich development of the plancton and as a consequence of this of the other fauna. Yet I do not suppose that an eventual lesser abundance of food in other rivers will have great influence upon the relative composition of the fauna. As a consequence of less food the number of individuals will decrease but the relative composition of the fauna will be influenced in a much lesser degree. Of course a change of the foodcomponents will have as a consequence a change in the components of the fishfauna. However, our knowledge of the biological equilibrium of the rivermouth is too imperfect yet to allow us to make any positive statements on this subject. Perhaps further investigations will throw more light on these problems.

The fishfood in the sea near Bagan Si Api Api, where most fishes have a length of below 30 cm, consists chiefly of *Sergestes*species, which are especially abundant on the central bank. (*Sergestes*species are here the object of a special fishery!). All stomachs which I opened, were filled with this little *Crustaceae.* I opened for this purpose the stomachs of about 10—20 specimens of each of the more important species.

Besides *Sergestes* I found sometimes other components which could not be identified and the remains of small *Annelids,* which however, I never saw alive. (Sometimes an *Aphrodite*-like worm is found in the jeremal catches, but this species is too big to serve as food for the small fishes found in these regions).

The predatory fishes, as the whole group of the *Plagiostomata,* mature specimens of *Cybium* and *Chorinemus,* big *Sciaenids, Chirocentrus* and others are of course not dependent on *Sergestes.*

It is obvious that the young fry is eaten also by the adult fishes.

XI. FISHERY PROBLEMS.

Two methods of fishing are practised in the area off Bagan Si Api Api, viz. by means of the jeremals and by means of the driftnets. [1])

[1]) The Si-Tsji- and the *Sergestes*- and the shrimpfisheries I do not take into consideration here.

The fishery by means of the driftnets is chiefly practised on the submarine continuation of the central bank and for the greater part outside the jeremal area. The water is not too clear there and it has the required depth of 8—9 m.

The jeremals catch chiefly small fish, with now and then a bigger specimen.

All small fish is salted wholesale, without selecting or cleaning. The result is not very palatable and the dried and salted fish is brought into the trade under the attractive name of Ikan busuk (= rotten fish). This Ikan busuk is one of the main articles of trade of Bagan Si Api Api.

On the drying-floors some species are selected out of the mass and these species are packed and dealt with separately. The remaining part is the true Ikan busuk.

The following species are selected.

1. Ikan Goelamah. Small specimens of *Sciaena* and *Sciaenoides.*
2. Ikan Bilis. *Stolephorus baganensis.*
3. Ikan Biang Biang. *Setipinna breviceps.* Only the bigger specimens.
4. Ikan Senangin. *Eleutheronema tetradactylum.*
5. Ikan Kembung (Selar). *Megalaspis cordyla.*
6. Ikan Trubuk. *Clupea toli.* Only the bigger specimens.
7. Ikan Puput. *Pellona species.* Only the bigger specimens.

Big fishes not mentioned above, as they are caught by the jeremals or by the driftnets, are either consumed fresh or are cleaned and salted.

A quarrel of long standing prevails between jeremal- and driftnet fishermen.

The jeremalfishermen maintain that the driftnets scare away the fish, so that the jeremals get smaller catches. Indeed a policeregulation says, that it is forbidden to have driftnets afloat within a distance of five hundred meter in front of a jeremal. It is difficult, however, in practice, also in relation with the strong currents, to enforce the above named regulation and endless rows are the result.

The driftnet with its meshes of 8 cm cannot catch away the fish of the jeremals. At most the latter will take somewhat fewer big specimens.

How far the statement, that the driftnets scare away the small jeremalfish, is true, is difficult to ascertain. This should be done experimentally.

Yet the loss caused to the jeremals, cannot be very great for it is in the driftnet fishermen's own interest to stay at a proper distance from the jeremals.

When the driftnet is carried away by the current to the row of palmstems, they cannot get it back without damage.

On the other hand driftnetfishermen have a grudge against the jeremals as more and more jeremals are built on the submarine continuation of the central bank in a northwestern direction. Their fishing area is situated in a wide curve round the jeremal area from Panipahan to Seneboei. (These two settlements are chiefly inhabited by driftnetfishers). The driftnets are driven more and more to the seaward and into clearer water by the advancement of the jeremals. The driftnet area is threatened to be cut into two parts by this advance.

The fear of the driftnetfishermen, that they will have smaller catches in deeper and clearer water is probably unfounded, although it is a fact, that elsewhere in the Archipelago driftnets are used with success in deeper and clearer water also. But in general it cannot be denied that fishes are more numerous in the more troubled water along the coast and near the rivermouths.

It is also possible of course, that the catches in deep and clearer water will consists of species not so highly esteemed. In connection with the above we have to consider also the fact, that the submarine continuation of the central bank will become less and less deep in the course of time. This natural factor is the cause, that it is possible for the jeremals to shift their position more and more to the seaward, as their depth-limit (8—9 m) shifts outward at the same rate. For this reason the driftnetfishermen will have to shift their position in the same direction, as the sea will become too shallow for them.

Now it is evident, that in relatively so limited an area, where fishing is carried on so intensively, the question of over-fishing will arise.

The problem of over-fishing has already been examined by Dr. SUNIER who visited Bagan Si Api Api in 1913 and 1914. His conclusions, however, were of a theoretical nature only.

Dr. SUNIER, formerly head of the Laboratory for fisheries at Batavia, mentions, in a report on Bagan Si Api Api; which has not been published, three factors, by which the amount of fishes in a given area may decrease.

These factors are:

1. Natural circumstances; A change in the conditions of life may have lead to a decline of some species or even to their complete disappearance.

2. Over-fishing. Over-fishing will affect first those species, which pass their whole life-cycle within a limited area. As intensive fishing will prevent the animals growing old, the bigger specimens will disappear first out of the catches. If this condition continues the fishes will become smaller and at the same rate the percentage of immature specimens will increase. Species with a wider distribution will have of course a continuous fresh supply from outside the area.

3. An exhaustion of the supply of young fishes by the catch of too much fry. As we have seen above much young fry is caught by the jeremals as well as by the shrimp- and Sergestesnets.

The dealers and sometimes the fishermen also complain of a falling off of the quantity as well as the quality of the fish. Especially big fishes (of more than 30 cm) seems to have been more abundant in former times.

Dr SUNIER paid already some attention to these complaints, which cannot be verified as reliable statistics are absent. We can only judge by the total figures of the annual catches. Now the totals of the annual catches will be influenced not only by natural causes but also by economical factors and they can therefore be used only with much reserve, when considering such questions as over-fishing.

Statistic of the total catches of fish in millions of kg.

1898	12.7	1913	20.4
1899	12.5	1914	19.2
1900	12.0	1915	19.9
1901	18.0	1916	19.1
1902	19.7	1917	19.1
1903	23.8	1918	21.7
1904	25.9	1919	21.7
1905	24.1	1920	22.8
1906	23.8	1921	22.6
1907	23.2	1922	22.5
1908	20.4	1923	21.1
1909	20.0	1924	21.6
1910	18.2	1925	24.0
1911	18.2	1926	25.8
1912	19.2	1927	21.0
		1928	21.2

The table given above, shows a considerable increase until 1904, with 25.9 millions of kg. This increase is caused by the expansion of the fisheries during these first years of the growth of Bagan Si Api Api. After 1904 we see some fluctuations [1]) in the total of the catches, with a minimum of 18.2 in 1910 and a maximum of 25.8 in 1926, a maximum which attains nearly the total of 1904! Fluctuations like these will of course, always occur and are to be found in every branch of fishery. Yet the total catch pro jeremal must have decreased somewhat, as the total number of jeremals has increased.

It is very difficult to decide if we have to do here with over-fishing. This will be impossible as long as the average jeremal-catch pro unit of time is unknown and as long as statistics for each separate species are not available. It is also unknown whether the average length of the different species has decreased or has remained the same. A comparison with the fauna of other rivermouths, in which the fisheries are not so intensive, showed that the different species had about the same average length.

Yet these comparisons may not be overvalued, as too little is known as yet of the biology of a given species and too little is known about the local circumstances in the other rivermouths.

As pointed out above an eventual over-fishing will act first upon species which pass their whole life-cycle inside the fished area, species therefore more or less strictly confined to the rivermouths. However, if we consider now these species in the Bagan-area we find, that the catches show a fairly high percentage of mature individuals, if these catches are taken at places, which are not specially frequented by the young specimens, as e.g. on the central bank. We

[1]) It is unknown, whether these fluctuations concern the fishfauna as a whole or relate to a single or a few species only.

can see this at a glance from the records given for each species and also from the tables given for *Setipinna taty, Engraulis kammalensis* and others. Thus the facts as I found them did not give evidence of over-fishing of the area.

Of course each species will react in its own way upon intensive fishing. The reaction will depend entirely on the rate of propagation of that species.

Species, which spawn outside the fished area, are of course not so strictly confined to a rivermouth. Over-fishing will not have a direct influence on them, as these species will have a continuous fresh supply from regions farther away, where fishing is not so intensive.

It will not be easy to state over-fishing in an area, like that of Bagan Si Api Api, where we find fishing not of one or a few species, but of the fishfauna as a whole. Each species will react in its own way upon an eventual slight alteration of the local circumferences, as is always likely to occur in a region like this. A decrease in the number of individuals and a decrease in the average length needs not necessarily be the result of over-fishing. An extension of the central bank for instance, would cause many species to move more to the seaward and the numbers of mature individuals in the catches would decrease.

The following examples will show, how unfounded complaints about over-fishing sometimes are.

In 1929 I got a letter from the officials of Bagan Si Api Api in which they asked my attention for the complaints of dealers and purchasers, that the goelamah-catches were decreasing rapidly. Now the Ikan goelamah does not consist of a single species, but of several species of *Sciaena* and *Sciaenoides.* Thus it depends upon the biology and upon the rate of propagation, how each species will react upon an intensive fishery. This reaction may be quite different for each different species. It is true that some species as *Sciaena glauca* and *Sciaenoides biauritus* are common and others as *Sciaena belangeri* and *Sciaenoides pama* are rare, which however is not necessarily the result of over-fishing, as nothing is known about their abundance in previous years. It is remarkable for our purpose, that the common species wholly or partly spawn inside the fished area and that the rare species do not do so. This is just the reverse of what might be expected in cases of over-fishing.

Sciaena glauca and *Sciaenoides biauritus,* which form together the bulk of the "Ikan Goelamah" spawn inside the fished area (partly at least). The young fry is mostly found on the central bank and the more seaward jeremals catch chiefly mature individuals. Thus I took out of the catch of jeremal 571 a sample at rondom of 165 specimens of *Sciaena glauca* and only 27 individuals or 22.7% were immature. This fact, does not point to over-fishing. In many other jereamals we can find about the same percentages. (See the record for *Sciaena glauca*).

Now people said, that in the years 1928 and 1929 there had been a shortage of Ikan Goelamah as a consequence of over-fishing. A closer examination showed, that this shortage was probably due to other factors, viz. the following.

Ikan Goelamah is chiefly bought for the tin-mines of Billiton. In 1927 and previous years about 155000 kg. or less were required in total. The total

quantity required in 1928 was about 283000 kg and in 1929 about 204000 kg much higher therefore. In 1928 the shortage amounted to 9000 kg and in 1929 to 6000 kg for which other species of fish were sent. The dealers in Bagan Si Api Api told me that they had sent all the Ikan Goelamah, which they could get i.e. about the total catch of the whole fished area. In the years before 1928 big quantities of Ikan Goelamah were sold elsewhere.

We can shortly assume, that in this case the shortage of Ikan Goelamah was not due to over-fishing but to the sudden increase of the required quantities from 155000 kg in 1927 to 283000 kg in 1928 and 204000 kg in 1929. The total catches of Ikan Goelamah in 1927 and previous years are unknown as the only trustworthy data available are those of the quantities delivered to the tin-mines. It is certain however, that these quantities did not consist of the whole catch. At any rate it is impossible to come to any conclusion about over-fishing from the facts given.

It is true that in 1929 the total quantity was less than in 1928, but I think this must be due to normal fluctuations as it is improbable that over-fishing will produce such a sudden affect as is the case here. (A fall of 25—30% in one year!).

Closer investigations showed me also, that there was only a shortage in the months of August and September. It is obvious, that in these months the species of which the article of trade is composed, have partly migrated out of the fished area. Perhaps we have here a similar phenomenon as with *Stromateus cinereus*.

The fact, that there is a shortage in two months of the year only, does not confirm the supposition of over-fishing either, as in that case, it might be expected, that the shortage would not be restricted to part of the year only.

XII. SUMMARY.

1. The fished-area of Bagan Si Api Api is situated at Strait Malacca in front of the aestuary-like mouth of the Rokan-river. Its greatest breadth is about twenty and its greatest length is about 40 seamiles.

2. Permanent fishtraps, the so-called jeremals form the main method of fishing. These jeremals fish with the ebbtide. A jeremal consists of two long rows (sometimes with a length of 500 m) of palmstems which are placed in the shape of V. The medianaxis of this V lies in the direction of the ebbtide, by which the fish is dragged against the net. This net is hung up in a wooden paling behind the V.

Besides the jeremals driftnets are used, the latter more to the seaward.

3. The ebbtide flows fan-wise out of the funnel-shaped mouth of the river. North of the line Pulu Halang Bĕsar — Seneboei the current is bent to the eastward by the mainstream of Malacca Strait.

4. The jeremal takes all species of fish, which occur in its region. Qualitatively the catches give a good general idea of the fauna, but we can make use of the quantitative proportions with some reserve only.

5. A short outline is given of the most common animals, not belonging to the fishes.

6. 149 species of fish can be found in the area. Only seventy of them are more or less common.

7. The fishfauna is composed of a few families only. Thus the *Clupeids* are rich in species and individuals, and the *Silurid*families are rich in species, but poor in individuals. The *Percidae* (sensu latu) are only seldom found. Species as well as individuals are rare. Of the *Carangids* and *Scomberids* mostly the young animals only occur. The genus *Gobioides* is, as a fact, the only genus of the *Gobiids* which is represented by many specimens. The area off the Rokan-mouth has therefore its own distinct fauna, quite different from what is found more to the seaward.

8. The fishfauna can be divided into the following groups:

a. Species which pass their whole life-cycle in the fished area. The most important are *Setipinna breviceps* and *taty, Engraulis kammalensis, Raconda russelliana, Harpodon nehereus, Cynoglossus monopus* and species of *Gobioides. Sciaena glauca, Sciaenoides biauritus* and *Stromateus* belong also to this group as they spawn, partly at least, in the fished area.
It is probable, that *Coilia dussumierii* and *Kurtus indicus* belong to this group, though the young fry is unknown to me.

b. Species which live in the sea when adult and which live near the coast when young. The most important of this group is *Eleutheronema tetradactylum.* Furthermore the *Carangids* and *Scomberids.*

c. Freshwaterspecies, as for instance a few *Cyprinids* and *Polynemids* and some species of the *Silurids.*

d. More or less occasional guests.

9. The fished area can be divided into three parts:

a. The Central Area. *Gobioides*-species are the most characteristic. The area is situated on the central bank, in front of the rivermouth, between Pulu Halang Bĕsar and the coast of Bagan Si Api Api. Its seaward limit may be extended a little or drawn in according to the seasons. The bottom consists of soft mud.

b. The Eastern Border Area. Especially *Setipinna taty* and in a lesser degree *Engraulis kammalensis* and *Coilia dussumierii* are the most characteristic species.
This area is the largest and the most important one. It is situated in a curve on the outside of the Central Area. Pulu Halang Bĕsar is partly or wholy situated within it during the rainy or dry monsoon respectively.
The bottom consists of a clayish mud.

c. The Western Border Area. This area is the smallest. It is situated on a sandy bottom forming a narrow stretch along the coast of Panipahan. The fauna is here relatively poor, when compared with the two other areas. The most characteristic fish is *Stromateus cinereus.*

10. The accumulation of the individuals in front of the Rokan-mouth is evidently caused by the abundance of food, which is probably the consequence of the composition of the riverwater.

11. The more important species from a zoölogical as well as from an economical standpoint are all species, which spend their whole life-time inside the fished area. Only *Eleutheronema tetradactylum* is an exception to this rule. The fisheries of Bagan Si Api Api depends therefore for the greater part on the special estuarine fish-population.

12. No facts were found thus far, which point to over-fishing.

NAME LIST OF FISHES.

Scientifique name.	Chinese.	Malayan.	Chinese characters.
Chirocentrus hypselosoma.	Sei Toh.	Parang Parang.	西刀
Dussumieria spec.	Un.	Djapuh.	溫魚
Dorosoma chacunda.	Bok Hauw.		木扣
Setipinna breviceps.	Ing Hi.	Biang Biang.	黃魚
Setipinna taty.	Po Pi.		卜片
Engraulis kammalensis.	Ang Bĕl.	Bilis.	紅尾
Engraulis dussumieri.	Oh Tjit.	Bilis.	烏鯽
Stolephorus spec.	Tjoh Kang Hi.	Bilis.	粗江魚
Coilia dussumierii.	Hong Bĕl.		尾鳳
Clupeoides lile.	Koa Pak Kang.	Tjangtjang Rebung.	闊北江
Clupea toli and *Clupea macrura.*	Tji Kap.	Trubuk.	刺殼
Pellona spec.	Lat Hi.	Puput.	叻魚
Harpodon nehereus.	Si Tjeng.	Nomei.	絲定
Cryptopterus hexapterus.	Ikan Kuning.	Ikan kuning.	依干君冷
Arius spec.	Sieng Hi.	Dukang.	鯎魚
Plotosus canius.	Tho sat.	Sĕmbilang.	土殺
Muraenesox spec.	Moa.		鰻魚
Hemirhamphus spec.	Tjai Tjiam.	Kachang Kachang.	水占
Eleutheronema tetradactylum.	Ngo Hi.	Sĕnangin.	鯃魚
Polynemus dubius.	Teng Tsjiu Ngoh.	Ikan Djanggut.	長鬚鯃
Polynemus indicus.	Sun Hong.	Senohong.	順風
Sphyraena spec.	Tek So.		梭德

Scientifique name.	Chinese.	Malayan.	Chinese characters.
Mugil spec.	Tjia Hi.	Bĕlanak.	只仔魚
Long Flatfishes.	Sin Tjek or Toa Sek.		龍舌塔西
Round Flatfishes.	Pei Hi.		鯿魚
Lates calcarifer.	Tsji Kap.	Kakap.	者蛤
Serranus fuscoguttatus.	Keh Hi.	Kĕrapu Matjan.	鱠魚
Therapon theraps.	Pang Mgo.		班紆
Pristipoma guoraca.	Tay Hiok.	Gĕrut Gerut.	抬額
Scatophagus argus.	Kim Koh.		金古
Proteracanthus sarissophorus.	Tjo Tauw Hi.	Ikan Batu.	石頭魚
Kurtus indicus.	Apien Hi.		亞片魚
Sciaena and *Sciaenoides* spec.	Gulamah or Samgeh.	Gulamah or Samgeh.	牛喃仔 三芽
Sciaenoides spec. (big specimens).	Ang Koa.	Kelampei.	紅瓜
Trichiurus spec.	Pei Hi.	Timah or Lajur.	白魚
Megalaspis cordyla.	Gie Bĕl.	Gie Bĕl.	尾硬
Scomberoides lysan.	Sampan Tiau.	Talang Talang.	三板跳
Stromateus cinereus.	Tjiu Hi.	Bawal Puti.	鯧魚
Cybium spec.	Bei Ka.	Tengiri.	馬加
Gobioides spec.	Tjak Kiu.		赤九
Sharks and *Rhinobatis.*	Soa Hi.	Yu.	鯊魚
Rays.	Hang Hi.	Pari.	魴魚

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CORAL REEF STUDIES.

II. THE DEPTH OF CORAL REEFS IN RELATION TO THEIR OXYGEN CONSUMPTION AND THE PENETRATION OF LIGHT IN THE WATER.

By

J. VERWEY.

(Laboratorium voor het Onderzoek der Zee, Batavia).

Introduction.

Measurement of the oxygen content of coral reef water, which I made in connection with ecological work, showed that the oxygen consumption of a reef can be so considerable that the water around it may become deprived of a large part of its oxygen. This fact brought me to the much discussed problem of the relation existing between the development of reefs and their want for light. It occurred to me that this problem could be approached if there could be shown to exist a correlation between the depth of the living part of certain reefs and the silt content of the water around them, as the silt content must influence the penetration of light in the water. If I should succeed in proving such a relation to exist, this would be a very strong argument in favour of the dependence of coral reefs on light. The observations in question were carried out in the years 1928—1930 in the Bay of Batavia and the work had to consist of observations on:

1. the oxygen production and consumption of reef corals and coral reefs;
2. the influence of currents;
3. the silt content of the water;
4. the depth of light influence;
5. the depth of the living part of the reefs in question.

The observations were all made at or in the neighbourhood of the island Onrust in the western half of the Bay of Batavia. As already stated in a previous paper, the aquarium built on this island in 1928 for the Laboratorium voor het Onderzoek der Zee offers quite unique opportunities for the study of coral reefs. It is fed with water pumped up from the reef, receives full sunlight, and all kinds of reef animals flourish here as on the reef itself. Thus the work was in first instance made possible through the kindness of the authorities of the Medical Service, Batavia, as Onrust is their Quarantine Station for Java. For the flourishing of this aquarium, however, its construction, the care for its welfare, we are indebted in the very first place to the intense interest in scienti-

fic work of Mrs. and Mr. STEINFURTH, medical officer and administrator to the Station, to whom no trouble was too much, each new fact a revelation. It is largely due to their devotion that the Laboratory at Batavia now offers working opportunities in the dutch tropics, which are hardly surpassed by those of any other tropical marine biological station.

One will see below that I further owe many thanks to Dr. S. W. VISSER and Dr. H. P. BERLAGE, of the Meteorological Observatory at Batavia, for valuable help in connection with solar radiation and some other problems. Finally I am indebted for help to Ir. B. MARKUS of the Visscherij Station, Batavia, and Dr. Ir. C. P. MOM, director of the Proefstation voor Waterzuivering at Manggarai, Batavia. And I thank Prof. DELSMAN for reading the manuscript.

1. THE OXYGEN CONSUMPTION OF REEF CORALS AND CORAL REEFS.

In June and July, 1928, in studying the small lagoon of the coral island Hoorn in the Bay of Batavia, I made a number of oxygen measurements of the lagoon water at different times of the day, to see whether there would be a daily rise and nightly fall in the quantity of oxygen due to assimilation and respiration respectively. The measurements were made during a period in which the inrush of new seawater into the lagoon fell during late afternoon and early evening, so that the lagoon did not receive any renewal of water either in the morning or in the second half of the night. For that reason it was to be expected that increase and decrease in oxygen should be considerable and the results bore out this conclusion.

TABLE I.

	Time of day	Oxygen content (cc. per litre)		
		2nd lagoon	3rd lagoon	
water falling.	6—8 a.m.	2.4,2.4	1.6,1.8,2.3,2.7,3.5,3.8	Temperatures ranging from 27.5 to 30° C., giving saturation of seawater (about 18‰ Cl) with 4.8 4.5 cc. of oxygen per litre.
	8—10 „	4.1,4.6	3.7,3.9,4.4	
	10 12 „	6.-,6.6	5.4.5 9.6.3,	
	12—3 p.m.	4.6,6.5	6.4(9.-),7.9,8.9(9.4) [1]), 7.6(9.5)	
water rising	3—6 p.m.	7.6	5.3,6.8	

To make possible a comparison of these figures with those for the sea outside the shingle wall, measurements were also made of the water above the reef, some metres from the shingle wall. These few observations tended to show that the water of the sea close to the shore above the reef shows the same daily rise and nightly fall in the quantity of oxygen, though probably to a lesser extent.

[1]) The figures between brackets are duplo-figures, differing much from the preceding figure. In such a case one of the two or both values are false.

TABLE II.

Time of day	Oxygen content (cc. per litre)	
6 — 8 10 — 12 12 — 3	2.1,2.1,3.2 5.6.5.7 4.-(5.1)	Temperatures ranging from 27.°5 to 29.°2, giving saturation of sea water with 4 8 — 4.65 cc. oxygen per litre

To see the influence of rising water I again made a series of measurements in February, 1929, when the water was rising in early morning, falling during the afternoon. I now chose the east side of the island Onrust, where the reef is living in shallow water close to shore, but also in open communication with the sea. As it was westmonsoon now, the place represented the lee side of the island.

TABLE III.

Time of day	Oxygen content (cc. per litre)	
6 — 8 8 — 12 12 — 3 3 — 6	1.5,3.4,3.9,4.-,4.2,5.3 4.6.4.7,5.4,5 7,6.3,7.- 5.4.5 5,6.2.6 2(5.5?). 5.-,5.1,5.1,5.5	Temperatures ranging from 28.°1 — 29.°8, giving saturation of sea water with 4.8 — 4.5 cc. oxygen per litre

These measurements show that even where the water is rising in early morning (beginning from 4 to 6 o'clock during the days of the observations) there is a very important difference between the oxygen content in the early morning and during the afternoon. From the place where the water was taken to the edge of the reef, a distance of 30—60 metres only, the water is becoming very gradually deeper and though the current along the reef's edge is of little influence over the shallow reef itself, the water above the reef is in open communication with the water of the sea around.

I did not measure the oxygen content of the water around the reefs during the days of the observations. Generally spoken we certainly may assume that the water of the open sea is always more or less saturated with oxygen and does not show a distinct diurnal variation. Therefore I did not bother about oxygen measurements in the open water during those days. However, to exclude the possibility of making fault assumptions in this direction, I lateron made a small series of measurements of the open water between the reefs. I let them follow here and also mention some earlier observations, which were made in other connection.

During a trip to the Thousand Islands in the southwestern Java Sea, on 25—27 July, 1928, I made a number of measurements at different times of the day and during the night. They gave bad figures, as the controls differ much

from one another, but all 12 values show saturation or supersaturation with oxygen (water 8 m deep). The same holds good for 8 measurements (also bad figures) made in the western half of the Bay of Batavia on 25 August, 1928, 7.30 a.m.—2.30 p.m. — On 4 September, 1930, 7.15 a.m., I found 5.52 cc. oxygen p. l. for the water near Onrust. So there was supersaturation in early morning [1]). In the afternoon (2 p.m.) I found at the same place a value of 5.75 cc. p. l. (temperatures 28°.1 and 29°.5 resp.). — On 12 October 1930, between 6.30 and 8.30 a.m., I found about 5.-cc. for water between Batavia and the island Edam (eastern half of Bay of Batavia, 4 measurements), in the afternoon I found 5.2 there (3 measurements). So this water too showed slight supersaturation in early morning (temp.: 28.2—29.9). — On 17—19 October I made a series of measurements in the open water between Onrust and Purmerend. The water was 10.5—12 m deep and the samples were taken from 3 m deep. They yielded the following results.

TABLE IV.

Date	Time of day	Temperatures	Oxygen in cc. p. l.	S in ‰ [2])	Cl in ‰ [2])
17 X	5.45 a.m.	28°. 7	5.12, 5.08 = *5.10*		
	9.—	29°. 6	5.13, 5.14 = *5.14*		
	9.50	29°. 7	5.02, 5.02 = *5.02*	32.80	18.16
	10.25	29°. 9	5.14, 5.16 = *5.15*	32.61	18.05
	11.30	30°. 1	5.14, 5.14 = *5.14*	32.63	18.06
	2.55 p.m.	30°. 4	5.13, 5.16 = *5.15*	32.89	18.21
	3.50	30°. —	5.06, 5.08 = *5.07*		
	4.40	29°. 3	5.21, 5.21, 5.18 = *5.20*		
	5.15	29°. 5	5.37, 5.37 = *5.37*		
18 X	5.30 a.m.	28°. 8	5.38, 5.34 = *5.36*		
	6.50	28°. 9	5.35, 5.31 = *5.33*	32.98	18.26
	8.40	29°. 2	5.34, 5.35 = *5.35*		
	9.25	29°. 5	5.27, 5.28 = *5.28*	32.84	18.18
	10.35	29°. 6	5.11, 5.16 = *5.14*		
	11.15	29°. 5	5.21, 5.23 = *5.22*	32.84	18.18
	2.— p.m.	30°. 2	5.25, 5.27 = *5.26*		
	2.45	30°. —	5.10, 5.15 = *5.13*	32.95	18.24
	3.20	29°. 8	5.38, 5.41 = *5.40*		
19 X	10.— a.m.	29°. 5	5.51, 5.51 = *5.51*		

In these same days I also made some measurements at other places round Onrust. They are not even of local interest, but again show high figures.

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[1]) Sea water of 28°-30°C. is saturated with oxygen when it contains 4.8-4.5 cc. per litre.

[2]) Calculated from areometre readings with the use of KNUDSEN's tables.

TABLE V.

Place of Sample	Time	Temper.	Oxygen
South of Onrust	16 X, 3.15 p. m.	29°. 9	5.18 ,5.20 = *5.19*
East of Onrust (waves)	3 45	30°. 1	4.97 ,5 10 = ± *5.—*
South of Purmerend	4.15	29°. 9	5.18 ,5.13 = *5.16*
North of Purmerend (waves)	4.45	29°. 8	5 12 ,5.13 = *5.13*
On reef south of Kerkhof	5.15	29°. 8	4.97 ,4.86 = *4.90*
East of Onrust outside reef	17 X, 6 05 a. m.	29°. 1	5.20 ,5.15 = *5.18*
On reef east of Onrust	6.30	28°. 9	3.72 ,3.80 = *3.76*
On reef nearer to island	7.—	28°. 5	4.17 ,4.20 = *4.19*
Between Onrust and Purmerend	18 X, 5.30 a. m.	28°. 8	5.38 ,5.34 = *5.36*
Edge of Onrust-reef	6.—	28°. 7	4.70 ,4.73 = *4.72*
On reef east of Onrust	6.25	28°. 9	4.80 ,4.79 = *4.80*

I give these observations in extenso, as they reveal several peculiarities. As sea water of 28°.5—30° C. and 18$^0/_{00}$ Cl is saturated with about 4.70—4.60 cc. O_2 p.l. (I use the table of Fox in HARVEY, p. 60), we first of all see that the water in the shallow Bay of Batavia is supersaturated with oxygen night and day, at least during the days of the measurements. Secondly we see that there are slight but distinct variations in oxygen content of one and the same place (extremes 5.02 and 5.51 cc. p. l. in 3 days), though there is no regular diurnal variation with a maximum and minimum. Probably these variations are due to currents. Thirdly some few measurements of reef water confirm the earlier observations that the reef water may show figures different from those of the water around the reefs. The reason why these differences in this case are not greater, is to be found in the time of rising of the water: the second half of the night.

From table IV one will see that there occur slight variations in the oxygen content of the water, which are of short duration only. So, for instance, a measurement of 5.02 cc. between an earlier and a later one of 5.14 and 5.15, and so on. I think these variations are real variations, but the possibility is perhaps not wholly to be excluded that the stopping of the motorboat, stirring up the water, may cause a slight loss of oxygen of the supersaturated water, one time more than another. As I came to this assumption after the work had been finished, I made no control measurements in this direction. There is no possibility that these variations are due to fault measurements, as the controls differ very little.

These few measurements, as far as they permit such a conclusion, show that the water of the shallow Bay of Batavia is night and day supersaturated with oxygen, at least during calm weather. For when during "bad" days in the west monsoon the silt is stirred up and brought into suspension (see below), there will probably be a short of oxygen instead of too much. Whether plankton or bottom algae or both cause this supersaturation, I do not know. But it is clear that these observations are further proof of the remarkably low figures for the oxygen content of reef water in early morning.

The rule of the absence of a distinct diurnal variation in the oxygen content of water in the open tropical sea does not always hold. On 27-30 September, 1928, Ir. B. MARKUS made a series of observations during a trip from Java (Indramaju) to Borneo (Kumai). They were made at the request of Prof. DELSMAN in a period when wide patches of the alga *Trichodesmium* covered the Java Sea. All samples were taken from a depth of 3 m whereas the depth of the sea ranged from 36 to 52 m. [1])

TABLE VI.

Date	Hour	Temperature	Oxygen
27 X	8.13 a.m.	28.3	3.62
	9.20	28.6	3.94
	10.07	28.4	4.25
	10.44	28.5	4.24
	11.30	28.6	4.56
	1.24	28.5	4.67
	2.15	28.7	5.12
	3.32	28.6	5.57
	6.—	28.3	5.16
	9.30	28.2	5.11

The following day, 28 October, gave no such a low minimum in the morning, nor such a high maximum in the afternoon, the five values ranging from 4.89 to 5.— cc. p. l.

It follows from these observations that large quantities of phytoplankton may cause a distinct diurnal variation in the oxygen content of the water in the open sea, giving a rather important under- and supersaturation; that, in general, however, this diurnal variation in the oxygen content of the open water is of little importance, at least in calm periods, and that shallow water like that of the Bay of Batavia may even be continuously supersaturated with oxygen. Supersaturation seems to arise very easily, and even a rather strong wind does not succeed in causing much oxygen loss; in the same way a rather strong wind on the reef does not prevent a strong undersaturation.

These observations on supersaturation of open water show that the large variations in the oxygen content of reef water are the more important. They show that the consumption of oxygen by a coral reef, this enormous block of living matter, must be enormous. Assuming that only a body of water of 100 metres along the shore, 10 metres across and 2 metres deep shows a lowering of the oxygen content from 5 to 3 cc. p. l., whereas this water is in more or less open communication with the sea, there must be a consumption of much more than 4000 litres of oxygen during one single night.

Before proceeding, however, we first may ask whether this consumption and production of oxygen of coral reefs cannot be measured more directly.

[1]) I have omitted the figures for the neighbourhood of the coast.

Production: It is to be expected that higher algae as well as the zoöxanthellae, which live within the coral tissues are the cause of the large production of oxygen. As to higher algae one can directly see the continuous stream of small bubbles, in smooth shallow water rising to the surface in direct sunlight. The more shallow parts of the reefs (in the Bay of Batavia down to a depth of about 5 m), in so far they are not wholly covered by corals, are covered with a silky carpet of fine green algae. Large tables of *Acropora,* turned over by the waves, die, while their undersides get covered with these algae; the same happens with broken corals, the bottom of sand or coral fragments, etc. This zone therefore becomes the home of large bands of parrotbill fishes, especially *Pseudoscarus dubius* (BENN.), *pyrrostethus* BLKR, *cantori* BLKR and *fasciatus* VALENC., which feed on these algae, scraping the coralrock covered with them with their sharp "teeth". It is especially this zone which produces large quantities of oxygen.

As to oxygen production through zoöxanthellae I made the following measurements.

On 22 February, 1929, 6.30 a.m., 4 jars, with a content of 9.3 l. each, were filled with unfiltered sea water. This was done by means of a siphon in such a way that the water was not mixed with oxygen in filling. The water was taken from one of the tanks of the Onrust Aquarium, the oxygen content of which had been measured directly before filling and found to be 3.25 cc. per litre (3.25, 3.27). The jars were put in the dark until 8 a.m. In the mean time 3 (wet) pieces of *Acropora hebes* were freshly collected and later weighed under similar conditions. At 8 a.m. the pieces of coral were put into the jars.

Jars 1 and 3 were hung in full sunlight in one of the aquarium tanks, the cover just under the water surface, in order that the temperature remained constant. The other jars, 2 and 4, were put into a dark room. The proof yielded the following results.

TABLE VII.

Number of jars	Weight of *Acropora hebes* in gr	Kept in light or dark	Duration of experiment	cc. O_2 per litre at beginning	cc. O_2 per litre at end	Increase in O_2 (cc. p.l.)
1	83.5	in the sun	8 a.m.—3 p.m.	3.25	6.04 (5.96,6.11)	2.79
2	71.3	in the dark	8 a.m.– 3.30 p.m.	3.25	2.28 (2.08,2.47)	-0.97
3	73.1	in the sun	8 a.m.—4 p.m.	3.25	5.78 (5.53,6.06)	2.53
4	no coral.	in the dark	6.30 a.m.— 4.15 p.m.	3.25	2.84 (2.82,2.86)	-0.41

Though these observations give us some insight into the matter, their value is not great. The duplo-figures found at the end of the experiment for the jars 2 and 3 differ much inter se. Moreover the decrease in oxygen of jar 4 shows

that organic matter used up 0.4 cc. of oxygen p. l. from 6.30 a.m. (when the jars were filled) until 4.15 p.m., i.e. somewhat less than 0.04 cc. p.l. per hour. — 71.3 gr *Acropora hebes* and suspended matter of jar 2 used up about 1 cc. of oxygen p.l. during the experiment. Assuming that the organic matter was about the same in all the jars, the latter may have used up about 0.36 cc. p. l. and the coral may have consumed 0.60 cc. p. l. in 7.5 hours, i.e. for the whole jar 9.3 $\times$ 0.6 = 5.58 cc. As 73.1 cc. of coral and the organic matter in jar 3 produced in the sun 2.53 cc. p.l. and may have used up about 1 cc. of oxygen p.l. (compare jar 2), the total production of oxygen may have been 3.5 cc. p. l. or for the whole jar somewhat more than 30 cc. in 8 hours. We do not know if the organic matter consisted of algae, other plankton or detritus, but we may safely assume that the production of oxygen by the coral was about 5—6 times larger than the consumption.

On February 23rd I repeated the experiments with filtered sea water, the oxygen content of which amounted to 2.55 p. l. (2.45, 2.51, 2.61, 2.62) at 8 a.m. when the jars were filled. The pieces of coral were cleaned with filtered sea water before being put into the jars. They had again been freshly collected and weighed wet.

TABLE VIII.

Number of jar	Weight of *Acropora hebes* in gr	Kept	Duration of experiment	cc. O_2 per litre		increase in O_2 (cc. p.l.)	temp. at end of experiment
				at beginning	at end		
1	60.85	in the sun	8.a.m.—1.30 p.m.	2.55	3.51(3.50, 3.52)	0.96	29.°8
3	73.85	in the sun	8.a.m.—2.30 p.m.	2.55	4.88(4.87, 4.89)	2.34	30.°9
4	no coral	in the sun	8 a.m. 3.— p.m.	2.55	2 51(2.50, 2.51)	0.04	31.°1
2	6C.5	in the dark	8.a.m.—3.20 p.m.	2.55	1.38(1.29, 1.46)	1.17	29.°4

The polyps of the corals were retracted during the experiment. Jars 3 and 4 contained under the cover a small number of air bubbles at the end of the experiment (due to the high temperature?).

These experiments show that the filtered water of jar 4 is practically devoid of organic matter (filtration found place with a piece of fine meshed plankton gauze) and that 60.5 gr of *Acropora hebes* consume in 7½ hours 1.17 cc. O_2 p. l., i.e. 0.16 cc. p. l. per hour. Further the total production of oxygen (measured production + consumption) may have been for jar 1 about 8 cc. p. l. in 5½ hours, for jar 3 about 3.4 cc. p. l. in 6½ hours. For the whole jar these values may have been about 16.7 and 31.6 cc. respectively.

If now we reduce all four values for the experiments of 22 and 23 February to production per jar per hour we get that 83.5 gr *Acropora hebes* produce 5.1 cc. of O_2, 73.1 gr produce 4.1 cc., 73.9 gr produce 4.9 cc., 60.9 gr

produce 3 cc. We can also express that in another way: 100 gr of *Acropora hebes* produce in full sunlight and shallow water 6.1, 5.7, 6.6, 4.9 cc. of oxygen per hour.

Consumption: The experiments cited above teach us at the same time something about the *consumption* of oxygen by *Acropora hebes* [1]). On February, 22, 1928, 71.3 gr consumed per hour about 0.74 cc.; on February, 23, 60.5 gr consumed in the same time about 1.5 cc. I do not know whether the consumption in the sun may be much more than in the dark, but we can safely assume that in shallow water the production of oxygen by coral zoöxanthellae during the day is about 2.5—5 times as great as the consumption of oxygen through corals and zoöxanthellae together.

If now we return again to the reef itself, we find that these figures are of much interest in connection with the low oxygen pressures found in early morning. 60 gr of *Acropora hebes* consume in one hour about 1.4 cc. of oxygen. So this coral consumes more than 20 cc. of oxygen per kilo and per hour. An ordinary colony of a large *Acropora* weighs from one to several kilos and thus consumes during one tropical night of 12 hours as many times 250 cc. of oxygen as it weighs kilos. According to such a calculation a reef of some thousands of kilos consumes several hundreds of litres oxygen during one night. And as we may say that the water around these reefs contains about 5 litres of oxygen per cubic metre we understand that such a reef is able to deprive about 120 cubic metres of wholly saturated water of all its oxygen. And we should not forget that this reef abounds with thousands of fishes, small and large, and numerous other animals, as well as algae. A kilogram of a small species of fish, MCCLENDON studied, "would use up all of the O_2 in 3600 litres of the sea water of the Gulf stream in 24 hours". "With 1 kg of fish in 300000 litres of warm sea water we should be able to detect a distinct fall in O_2 concentration during the night. In order to attain this effect there need be organisms, the equivalent of 1 kg. of fish, to 10 square meters of bottom in water 30 meters deep". One is indeed inclined to ask whether these reef animals do not suffer from a severe short of oxygen now and then [2]).

The same rise and fall in the oxygen content of the water of tropical reef flats was observed by MCCLENDON (1918), who made his measurements on the Florida Keys. His figures range from 3 to 4.5 cc. per litre about dawn to 4.5 to 7 cc. at 3 p.m.

MCCLENDON (1918, p. 277) remarks that this rise in oxygen content in Tortugas waters is due to "attached seaweed and symbiotic algae and diatoms at the bottom".

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[1]) Fuller details on the oxygen consumption of species of the genus *Acropora* are given in another paper of this series.

[2]) The toxic effect of CO_2 may, however, be independent of asphyxation, and this supposition is strengthened by the fact that with the exception of *Acropora muricata*, all of these corals (i.e. *Orbicella annularis, Porites astraeoides, P. clavaria, P. furcata, Maeandra areolata, Favia fragum, Siderastrea radians*) can survive in the dark for more than 11 hours in sea-water deprived of oxygen under an airpump; and even *Acropora muricata* can withstand 6 hours of this treatment (MAYER, 1918b, p. 175). — From this and other observations [HENZE, 1910 (anemones), KROGH, 1916, MCCLENDON, 1917 (*Cassiopea*)] we know that the rate of respiration in such animals is greatly affected by the oxygen content of the water and that therefore the reef will be able to stand low oxygen pressures a long time.

— "On coral reefs the symbiotic algae of corals and actinians are very effective, and in lagoons or other water which is not too agitated the symbiotic algae of the bottom medusa *Cassiopea* are a significant factor. One *Cassiopea xamachana* (11 cm. in diameter, weighing about 117 grams) in the sunlight gave out 1.9 c.c. O_2 per hour, whereas in the dark it absorbed 2.8 c.c. per hour, showing that 4.7 c.c. per hour was produced by the photosynthesis, at 30°. In other words, the O_2 given out in the day is about twothirds the amount used at night". — Though MCCLENDON remarks that the symbiotic algae of corals are very effective, measurements of the oxygen production of corals appear not to have been made by him. Observations on the oxygen production of coral zoöxanthellae were, however, made by the late ALFRED G. MAYER who remarks (1918 b, p. 176): "In these experiments the corals were kept in the dark to prevent photosynthesis in their commensal plantcells, for in sunlight the surrounding water soon becomes supersaturated with oxygen from this cause". As to oxygen production by Alcyonaria CARY (1918, p. 188) remarks: "This aquarium was covered with a black box to exclude the light, as some of the species studied contained within their tissues enough symbiotic algae (zoöxanthellae) to materially influence the results when the experiments were carried on in the diffuse light of the laboratory". As to actinians "the investigations of BRANDT (1883), TRENDELENBURG (1908) (working with *Anemonia sulcata*) and PÜTTER (1911) prove that actinians with zoöxanthellae may derive a large part of their oxygen from these algae, and that actinians with zoöxanthellae can better resist unfavorable circumstances than those which do not harbor unicellular algae" (BOSCHMA, 1925, p. 431).

As to the consumption of oxygen we know, especially from measurements of KROGH and MONTUORI and calculations of MCCLENDON the number of cubic centimetres of oxygen, used per hour per kilogram by various groups of animals. CARY has published observations for Alcyonaria and MAYER (1918b, p. 176) for corals. Especially the latter's figures are of much value to us. Whereas a kilogram of living tissue of *Siderastrea radians* consumes about 25 cc. of oxygen per hour, that of *Maeandra areolata* consumes 3.8, of *Favia fragum* 5.5, of *Orbicella annularis* 6.1 and that of *Acropora muricata* 18.7 times as much. Thus *Acropora muricata* consumes per kilo of its living tissue per hour about 500 cc. oxygen. Compared with the figures given for related animals — i.e. *Cassiopea* (26 cc.), Anthozoa (40), Alcyonaria (living tissue only) (14-75) — this figure and doubtless also that for *Acropora hebes* given above is very high, especially if one realizes that we are dealing with sessile animals. Higher, fast moving animals of course do show high figures: cephalopods and crustaceans 200 and more, fishes 200-500 cc. and more (compare the literature cited above). For Alcyonaria CARY has shown that those species which have the greatest surface for a unit of weight $\left\{\frac{\text{cm } 2}{\text{gr}}\right\}$ have by far the highest metabolism; this rule, however, does not hold, when different groups of animals are compared here.

The foregoing observations all tend to show that the quantity of oxygen, present in the water, must often be the limiting factor in reef growth. Of course there are many reefs, lying in more or less strong currents which do not bother about lack of oxygen. MEINDERT's reef, at the northeast point of Java, lying in the dangerous current of Bali Strait (a current of up to 8 miles per hour) has to endure such a strong flow of water that we might call it a typical current reef, many of the corals — especially *Acropora* — not growing upward, but in the direction of the current, bowing as trees before the wind. But when we take, on the other hand, reefs in bays or in the open sea, with only a feeble current, it is quite another thing. For that reason let us consider the influence of currents first.

2. THE IMPORTANCE OF CURRENTS FOR CORAL REEFS.

VAUGHAN (1914, p. 225), to study the influence of darkness on corals, placed 18 species, representing practically all the reef corals of Florida, in a submarine dark chamber and found that after 43 days most of them were very pale, due to the death of the algal symbionts, but in only 5 species did the corals die. More recently EDMONDSON (1928, p. 57—58) made a similar experiment in placing 17 species of Hawaiian corals in a floating dark box. Only 4 species survived the experiment, which had lasted 45 days. "All were more or less injured by the loss of coenenchyma and were very much paler than at the beginning of the experiment". Finally YONGE (1929) made the experiment for the third time and found that "corals, kept for four months in a light tight box on the reef flat showed no ill effects other than those caused by the heavy deposition of sediment which smothered some; the survivors were pale, almost all the algae being dead, but otherwise healthy". From these experiments one might be inclined to believe that the corals in general (i.e. the reefs) are perhaps able to grow without light, so that the latter cannot be the limiting factor as to depth. The point of interest, however, is not only whether it is possible to grow corals in the dark when they get enough oxygen and food, but whether the coral reefs themselves would be able to stand the darkness a sufficiently long time. We must keep in mind that nowhere else than on coral reefs it is possible to find such a dense population in such a small area. The heavy outbursts of plankton in the northern Atlantic in spring are nothing compared with the thousands of cubic metres of reef life in a sea which is filled up to the limits of possibility. The enormous numbers of fishes, which in the North Sea and elsewhere gave rise to such important fisheries, are in no smaller number met with on the coral reefs, where, however, they form only a small part of the total amount of living matter. Whereas in northern seas, through lack of plant life during winter, there is a gradual increase in phosphates and nitrates in the water, until these are used up by the phytoplankton after its outburst in spring, we are dealing here with a never diminishing production of phosphates, ammonium compounds and nitrates. In shutting off the light we would create the conditions occurring at greater depths, where the phosphates and nitrates are continually showing high figures. And so we should not ask whether corals may grow in the dark under artificial conditions, but whether the water on and round the reef is able to remove the waste products of the latter. Therefore we now may see what is known about currents in the Java Sea.

In the years 1914, 1915 and 1916 Mr. K. M. VAN WEEL, then hydrographer at the Laboratorium voor het Onderzoek der Zee at Batavia, and Capt. VAN KOESVELD made a number of current measurements in the Java Sea on six trips in the months of February, May, August and November. These months, under mean conditions, may be said to represent the westmonsoon, spring transition, eastmonsoon and autumn transition respectively. Their observations on direction and velocity of the currents were published in extenso by VAN WEEL (1923). His figures, together with those on salinity, temperature, etc., which for

a good deal had also been worked out by him, formed the basis for a paper on the monsoon currents in the Java Sea by BERLAGE (1927). — BERLAGE finds a very good agreement between the old observations on the monsoon currents, mentioned in the Nautical Guide, and the exact measurements of VAN WEEL and VAN KOESVELD. He compares the Java Sea with a rectangle with two large openings: one in the northern long side between Sumatra and Borneo and one in the eastern short side east and north of Madura. During the east monsoon the water is coming in through the lastnamed opening and flowing away through the northern one, in the westmonsoon the reverse is the case. But moreover the rectangle leaks in its southwestern corner, as the water is flowing out through Sunda Strait the year round. During the westmonsoon the strong wind through Sunda Strait is driving the water of the southwestern Java Sea in an easterly direction, this is only a superficial phenomenon, however. As to the direction of the currents at different depths in one and the same place, it nearly always tends to change clockwise or counterclockwise from surface to bottom; for these and other particulars the reader is referred to the papers in question. — To us the velocities of the currents especially are of much interest. The first point, attracting attention, is that there generally is a decrease in current velocity from surface to bottom. Especially the higher velocities show this phenomenon; the lower ones do not show it, I suppose because the instrument registrates these velocities less exactly [1]). The second point of interest is that the velocities — as may be expected — differ in the different seasons. This is already obvious from a superficial glance at the figures and was known long ago. The Nautical Guide gives the maximum velocities attained during east and west monsoon as 1 and 2 miles per hour respectively.

BERLAGE finds as mean current velocity during the westmonsoon 28, during the east monsoon 17 cm p. sec. To this purpose he has reduced all currents to east and west ones. We ourselves, however, do not need the precise east and west currents, but the currents as such, the directly observed ones, consisting of a mixture of tide and monsoon currents. The first are small but cannot be wholly neglected, as is shown by rather important differences in velocity of neighbouring or even the same places on one and the same day. For that reason I have calculated the means for the totals of the different seasons.

TABLE IX.

Depth in metres	5	15	25	
7 — 26 Febr. 1914	42	34	35	Westmonsoon: 40, 32, 30.
5 — 19 „ 1916	37	29.5	25	
6 — 22 May 1914	29	25	23	Transition spring: 24, 22, 19.
7 — 31 „ 1915	19	19	15.5	
3 — 19 Aug. 1915	32.5	29	27	Eastmonsoon: 33, 29, 27.
6 — 20 Nov. 1915	33	29.5	27	Transition autumn: 33, 30, 27.

[1]) For the same reason the direction of the currents is often not wholly trustworthy.

These figures show us that the lowest mean velocity for the currents in the Java Sea may be about 20 cm per sec. Now, when a current has a velocity of 20 cm per sec., it takes 5 seconds for a cubic metre of water to flow over a m^2 of bottom. Let us assume that the quantity of coral growing on that m^2 of bottom is 500—5000 times larger than the quantity of coral used in one of my experiments mentioned above. A rough estimation shows that this often may be the case. As in one of my experiments 60 gr of *Acropora hebes* consumed about 1.4 cc. oxygen per hour, 5000×60 gr may consume 5000×1.4 cc. per hour, or $\frac{5000 \times 1.4}{720} = 10$ cc. O_2 in 5 sec. If now this cubic metre of water flows along a piece of reef of about 100 m long, the corals would consume about 1000 cc. of its oxygen and the oxygen pressure of the water would sink about 20%, if there existed no diffusion, convection or other manner of intermingling. Whereas the rate of diffusion of oxygen in water is so small that it may be neglected, we possess no means of observing the influence of convection or another type of intermingling, so that we cannot go further into the matter. When, however, a feeble current is flowing over a shallow lying reef, there is probably little reason to assume that convection plays an important rôle and in such a case we are dealing with consumption only, whereas diffusion — as already stated — may be neglected.

The rate of diffusion of oxygen in water may be derived from the following formula:

$$dS = kq \frac{dc}{dx} dt \times 10^3.$$

dS is the quantity of oxygen, moving at the point x in the time dt through the section q under the influence of the difference in concentration; this difference in oxygen in fresh water; at 16°-17°C. it is 1.62, at 22° perhaps 1.64, so I assume that concentration is the change of concentration dc along the distance dx; k is known for at 28° it is about 1.66. — Let us assume that its value for oxygen in sea water is not much different. Let us further assume that the concentration of ogygen falls from 5 cc. to 4 cc. p. l. over a distance of 1 m = 100 cm and let us express dc in cm^3 O_2 per cm^3 H_2O.

Then the diffusion through 1 cm^2 amounts to:

$1.66 \times \frac{0.002}{100} = 0.0000332$ cm^3 in 24 hours, so that the diffusion per m^2 per 5 seconds (see above) is about 0.000002 cc.

So it is not impossible that the reef gets short of oxygen already when a current as mentioned before flows along the corals. — In reality, however, when a current of a certain velocity passes a reef, the corals themselves have to depend on water which is flowing much more slowly. Near the coralbottom, along and between the corals, the water meets so much resistance that we will find a basal layer of water there, which moves very slowly only. Where a reef has grown up to little below the surface we may see that the water is flowing scarcely over it, whereas some fifty metres farther, along the edge of the reef, it is flowing rather fast. When I measure a current

velocity of 10 cm p. sec. in the Bay of Batavia not far from Haarlem, I may be sure that the water flows along the corals with a velocity of perhaps 5 cm p. sec. or still less. In that case it takes 20 sec. for one metre of water to pass the corals and the corals on one m^2 may use up 40 cc. O_2 from that m^3 of water. If this water flows again along a piece of reef of 100 m long, 4000 cc. oxygen are consumed. And as this cubic metre contains only about 4700 cc. the corals get short of oxygen in a very short time. It may be easily understood that in this way low oxygen pressures may arise night after night.

3. SILT MEASUREMENTS.

The foregoing considerations lead us to the supposition that the depth from which a coral reef arises in calm water may often depend, from want for oxygen alone, on the silt quantity of the water. But for other reasons too it is quite probable that the development of coral reefs is influenced, directly or indirectly, by the silt quantity of the water, directly because the corals themselves may need light, indirectly because their zoöxanthellae need it and the corals may need these algae.

So it need not wonder us that the hypothesis has been advanced more than once that the depth of the living reefs is limited by the depth of light penetration. But as far as I know no one has tried to show if there exists a direct relation between the depth of the living reef and the average depth to which the light penetrates the water round about that reef. I already stated above: if we could prove that a high average of silt content (equivalent to reduced penetration of light) corresponds to a small maximum depth of the living reef, and vice versa, this would be a very strong argument in favour of the relation reef and light.

It is now generally recognized that the limit of most active coral growth lies at a depth of about 40 m. Sometimes much greater depths are reached by reef corals, but they probably build rarely reefs there. And where they do so, these reefs must be very uniform in composition, as only some very few species reach these greater depths. So QUELCH in his Reefcoralreport of the Challenger Expedition (p. 35) mentions only 3 species of corals from depths of up to 40 fathoms, which, according to him, are definite reef-builders: *Porites lichen, Montipora capitata, Pocillopora nobilis*; they are the only ones of nearly 300 species of reef-building corals.

CROSSLAND, in a recent publication even expressed his doubt as to the correctness of these statements, because .... on Tahiti he found no corals below 20 metres. One may ask why he did not conclude: the depth of the reef seems to be smaller in Tahiti than in other places. The reason for this is obvious. For whereas his reef reached to about 20 metres, the visibility reached about 12 m deeper; so opacity (silt quantity) of the water could in his judgment not be of influence. At first sight it might really seem, that CROSSLAND was right in his conclusions. If then, however, one reads, that the water was so clear under the best possible conditions only, one may ask: what would be the average depth

from which the bottom would be visible to our eyes? — So we have in the first place to study the variability in the quantity of silt of one and the same place, accompanying stormy and calm periods, at the same time learning the average quantity of silt for the place in question.

The measurements given below (Table X) were all made in the western half of the Bay of Batavia in the neighbourhood of the islands Onrust and Kuiper, Purmerend and Kerkhof, Schiedam, Rotterdam, Hoorn and Haarlem. They were made by using a variety of SECCHI's disc, modified after HEDLEY and UMBGROVE (UMBGROVE p. 4). As stated by HARVEY (p. 156—157) the measurements taken in this manner give a fairly exact idea of the quantity of floating matter (silt and plankton), the depth at which the disc disappears from sight not being affected by the intensity of light on the surface within fairly wide limits. In general the transparency of the water is larger when direct sunlight fails, as the floating particles disperse the light falling on them and largely throw it back; this is especially the case when the silt quantity is important. The difference in depth seeing may then amount to at its most 10%, perhaps even somewhat more. As the method itself is, however, so easy that it makes control measurements possible without much loss of time, the method is quite sufficient for our purpose. It should be remarked here that POOLE & ATKINS (1929, p. 309—310), who compared the readings of SECCHI's disc with those of their photoelectric cells, found that the percentage illumination at the limit of visibility may be said to be about 16% and "further that we may use the SECCHI disc to estimate the opacity of the water without paying attention to even comparatively large variations in the brightness of the daylight."

The figures thus obtained, though they represent the state of affairs during the westmonsoon only, distinctly show

1° that the quantity of silt — as may be expected — is immediately correlated to the depth of the water, so that round about the island Onrust the quantity of silt is always greater than round about the island Haarlem; with increasing depth of the water, however, especially on windy days, the depth increases faster than the visibility;

2° that it takes some time (at least three days) after a stormy or windy period before the large quantity of silt has settled again, so that the average quantity of silt during the monsoons is rather high.

During the transition periods the clearness of the water shows that higher figures for the visibility are to be found than during the monsoons. For that reason the average quantity of suspended matter for the whole year must be smaller than that for the monsoon periods. The mean disc visibility for Onrust may be 4, for Haarlem 8—10 metres; but these figures are still very hypothetical. In my preliminary paper I assumed a mean visibility of at its most 12 m for Haarlem; this figure will be too high, however.

In studying these figures one must well realize that the field of operation is situated close to the mangrove coast and that not only there, but farther from the coast too, the bottom — like that of a great part of the Java Sea — is

Table X.

Data	Weather	Near Onrust, Kuiper, Purmerend, depth 9—12.5 m [1])	Near Schiedam, depth 12—17.5 m	Near Rotterdam, depth 16.5—19.5 m	Near Hoorn, depth 18.5—21 m	Near Haarlem, depth 21 — 23 m
Jan. 21	Windy	4, 4, 4.				
23		4.5, 4.5, 4				
24		3.5, 3.5, 4	5			
25		3,5, 4.5	7, 8.5, 8	7		8
27	Very fine weather, nearly no wind, ± west.	3,5, 6.5	8, 7, 7, 7, 8	7.5, 8.5	10, 10.5	11.5, 11
Febr. 13	Strong wind, during the night much rain.	2, 1.8, 2.5		5	7, 5	7.5, 8.5
14	Nearly no wind, rain.	1.5, 3, 1,5	3, 3	4		
15	,, ,, ,, .	1.5, 2.6, 2, 2.2, 2.8,	5.2	6.6		
16	Rain during the night, wind W.	3.3, 2.8, 2.1, 3				
17	Rain, rather strong wind, W.	2, 2.5, 2.5				
18	Windy.	2.3, 3, 3.				
20	Sunny, strong W. wind.				6 — 7	
21	Sea rather calm. Little wind, W.	4, 5,		6.5	6	
22	Nearly no wind. Sea like a lake.	3.5, 5, 4.5, 4.	7, 6	7.5, 7	8	8, 10
23	Nice weather, no wind.	4.4, 4.3, 3 8, 4.3.	9.5, 9	8.8		
24	As 23	6.5, 6.3, 7 5, 5, 5.5,	11, 8	9.5		
March 9		1.6, 1.5, 1.5, 1.7,	1.8,	2.5	3	4
23		4	4.5	8.5	12.8	9
April 30		4.6		6.6	8	
May 9		8.6		7.6		
June 12					11	
13		6.6			12	
15		6.4		8,6		13.6
	median values =	3.7	6.7	7.—	8.3	9.1

[1]) All depths are given as measured on the days in question, without taking into account the water level.

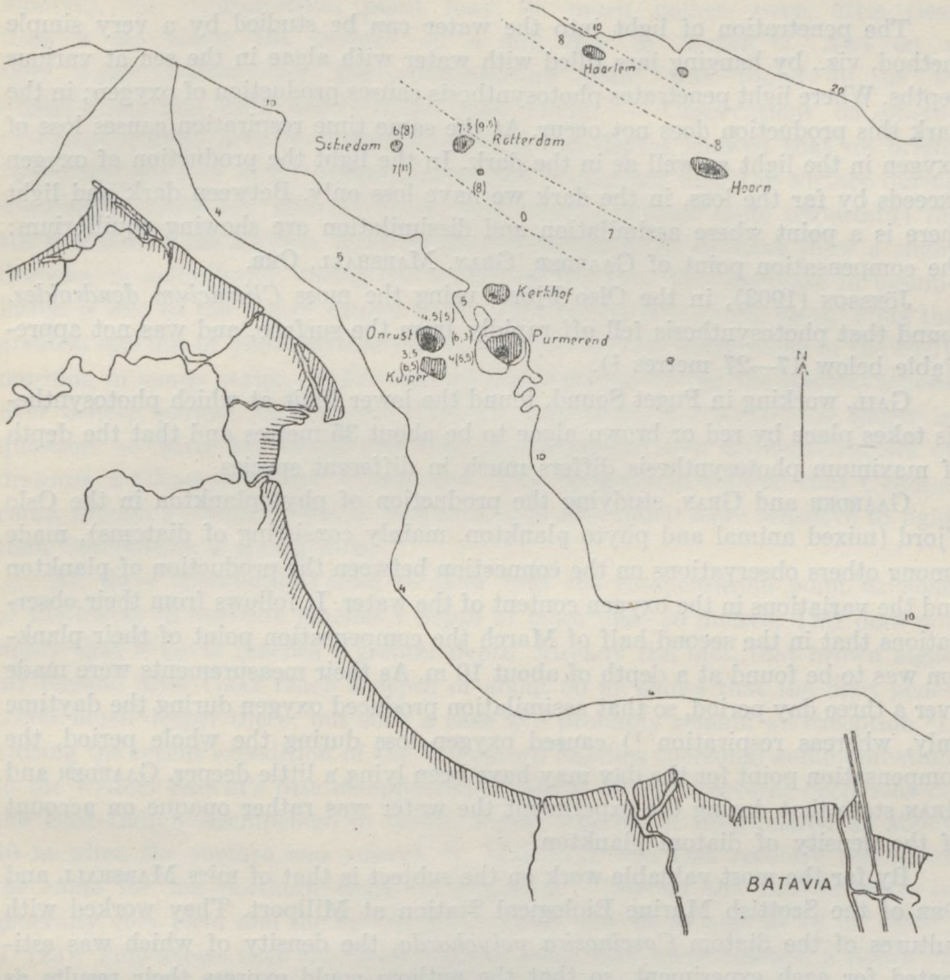

Fig. 1. Map of western half of Bay of Batavia, showing the lines of equal silt quantity running parallel with the coast. The figures represent the depths at which SECCHI's disc disappeared to the eye on 22 and (between brackets) on 24 February 1929.

covered with silt. This silt is stirred up by the influence of the waves and so brought into suspension when the wind grows strong enough, sooner or later, according to the depth. A moderate storm is able to stir the water up to a depth of 50 metres and more. "In the open Atlantic ripple marks have been found at a depth of 200 meters, but in the English Channel they occur only down to a depth of 40 meters, and to depths of 50 meters in the Roman mediterranean. Off the Florida coast, too, AGASSIZ has noted disturbances to a depth of 200 meters" (GRABAU, 1924, p. 218—219). One can understand that it is not possible for this silt to sink down again in one single day.

The accompanying map shows that the lines of equal disc visibility (i.e. silt quantity) run parallel with the coast.

4. DEPTH OF LIGHT INFLUENCE.

The penetration of light into the water can be studied by a very simple method, viz., by hanging jars filled with water with algae in the sea at various depths. Where light penetrates photosynthesis causes production of oxygen; in the dark this production does not occur. At the same time respiration causes loss of oxygen in the light as well as in the dark. In the light the production of oxygen exceeds by far the loss, in the dark we have loss only. Between dark and light there is a point where assimilation and dissimilation are showing equilibrium: the compensation point of GAARDER, GRAN, MARSHALL, ORR.

JÖNSSON (1903), in the Olso Fjord, using the moss *Climacium dendroides*, found that photosynthesis fell off rapidly from the surface, and was not appreciable below 17—27 metres [1]).

GAIL, working in Puget Sound, found the lower limit at which photosynthesis takes place by red or brown algae to be about 35 metres and that the depth of maximum photosynthesis differs much in different species.

GAARDER and GRAN, studying the production of phytoplankton in the Oslo Fjord (mixed animal and phyto plankton, mainly consisting of diatoms), made among others observations on the connection between the production of plankton and the variations in the oxygen content of the water. It follows from their observations that in the second half of March the compensation point of their plankton was to be found at a depth of about 10 m. As their measurements were made over a three day period, so that assimilation produced oxygen during the daytime only, whereas respiration [1]) caused oxygen loss during the whole period, the compensation point for the day may have been lying a little deeper. GAARDER and GRAN state that during the experiment the water was rather opaque on account of the density of diatom plankton.

By far the most valuable work on the subject is that of miss MARSHALL and ORR of the Scottish Marine Biological Station at Millport. They worked with cultures of the diatom *Coscinosira polychorda*, the density of which was estimated for each experiment, so that the authors could express their results as the amount of oxygen produced by a million diatoms. As far as possible cultures of about the same age and cell contents were used in their experiments and the experiments were preferably carried out while the sea was free from diatoms. Their valuable investigations therefore represent a unique piece of standardized work. — The principal results of their studies are the following. In inshore water the compensation point for a pure culture of *Coscinosira polychorda* (when measured over 24 hours) may lie at a depth of 10—20 m in March or 20—30 m

[1]) „Early experimental work on the effect of light at different depths was carried out at Monaco by REGNARD (1891), who germinated seeds of cress and radish at different depths, and found that little chlorophyll was formed at 30 metres" (MARSHALL and ORR, 1928, see also ATKINS, 1926, p. 103-104).

[2]) The term "respiration" is used here and furtheron to denote the consumption of oxygen. GAARDER and GRAN have shown, however, "that the auto-oxydation of dissolved and suspended organic matter, and the bacterial oxydation are very important factors in relation to the respiration of the phytoplankton". See also FÖYN & GRAN.

in summer when the water is clear. When the sea is rich in diatoms, however, the compensation point may lie much higher, even little (less than 5 m) below the surface on a dull day in March [1]). And on a very foggy winter day the compensation point was found to lie at about 2 m, the least depth which was found. — Observations on photosynthesis during three hour periods at different depths showed that on bright days there is a fall in the oxygen production of diatoms near the surface during the middle of the day, this fall being most marked (indeed quite important) for the diatoms at the surface. Even at six metres depth the diatoms show a slight decrease in assimilation during the middle of the day. This decrease in assimilation is due to the injury caused to the diatoms by the strong light. Thus the greatest amount of photosynthesis at or near the surface takes place in the early morning in sunny water. — For further observations, giving the photosynthesis over 3-hour periods on days of different brightness, I refer to the paper in question. — Miss MARSHALL and ORR also compared two different species of diatoms, a *Chaetoceras* and *Coscinosira.* This comparison showed that *Chaetoceras,* though a summer form in Scotland, appeared much more sensitive to light than *Coscinosira,* a spring form.

All these observations tend to show that the compensation point at none of the places in question reaches a depth of more than 30 metres. This does not imply that it never reaches a greater depth. Already the fact, that brown algae off Iceland after GRAN reach a depth of about 50 m, shows that the light penetrates much deeper there; but such a case will probably remain an exception [2]). During the recent expedition of the Willebrord Snellius (personal communication to the writer) SECCHI's disc disappeared at about 30 m in several deep seas of the East-Indian Archipelago in turbid water, whereas it disappeared at about 40 m when the surface was smooth [3]). MARSHALL and ORR recently remarked the same for the northern coast of Australia: "Beyond the Barrier water is generally very clear and the SECCHI disc reading may be as high as 40 m" (1931, p. 123). This shows that the compensation point may have reached a depth of 50—60 m at these places (see below). But such a deep lying compensation point is just found over these large depths only.

My own researches intended to make out how far the influence of light would reach under the different conditions caused by the silt contents as given above. So I made my measurements on the oxygen production of algae together with comparative readings of the white disc. I too used the method of hanging

[1]) Fuller details on the influence of dense diatom plankton on the penetration of light in the water are given by MARSHALL and ORR 1930, p. 865-866; POOLE and ATKINS (1929) found evidence of a decrease in the intensity of illumination due to the zooplankton.

[2]) In the Mediterranean according to WALTHER the red algae reach a depth of 130-160 m, but it is practically certain "that the red algae can and do utilise light at the blue end of the spectrum, since they live at depths to which little but blue light penetrates" (HARVEY, p. 17).

[3]) The disc was observed from 3-3.5 m above the water surface. In my own observations when necessary a sea glass was used to take away the rippling of the water surface, so that the latter little influenced the results.

jars with sea water and algae at different depths in the water. For technical reasons I preferred to use the largest possibly jars, i.e. of about 9.3 litres. They can contain a larger quantity of algae and make control measurements possible twice, when the results seem doubtful. The oxygen quantity was measured after WINKLER, but at the advice of Ir. MARKUS I did not use the ordinary oxygen jars, but the oxygen pipet with two cocks after ROMIJN. As may be wellknown and is shown moreover by the series of measurements given in table IV this pipet gives exact duplo-figures, if one takes care that each time the same quantity of $Mn(OH)_2$ gets lost. It took a long time, however, before I sufficiently realized that rather important differences in the duplo-measurements may be caused by small differences in the amounts of lost $Mn(OH)_2$ and for that reason several of the duplo-measurements in the beginning gave bad figures.

GAARDER and GRAN worked with mixed phyto and animal plankton (principally diatoms), miss MARSHALL and ORR with diatom cultures. In connection with the problem under consideration I concluded that for my purpose it would be best to study bottom algae, as the latter, together with the zoöxanthellae of the corals, are of importance for coral reefs. I collected these algae from the wall or from the bottom of the tanks of the Onrust Aquarium and weighed them wet, i.e. after having spread them out on a piece of gauze for a short time. This weighing of wet matter had of course the disadvantage that the portions were not exactly alike and for that reason it was a fault that I did not weigh all algae dry after the experiment was over. I did so the second time and one will see that the greatest deviation from the median value amounted to 13% of the latter, whereas the greatest difference between the lowest and highest value amounted to 25% of the lowest value. These figures are high. — The algae used during the first experiment consisted probably of a species of *Bryopsis*, probably with a very rich growth of diatoms and a number of protozoans. Those used in the second experiment consisted of a species of *Cladophora*, nearly without any growth of foreign organisms.

The jars had a height of 0.75 m, hung vertically and the algae covered their bottom. Thus the light partly had to pass the thick cover, partly the jars themselves. The depths to which the jars were lowered were measured from the surface of the water to the bottom of the jar.

The jars hung down from long bamboos which had been fastened crosswise to the small rowing boat of our Laboratory. The bamboos projected about 3 m to the left and right of the boat. It was believed that through this procedure the shadow of the boat could never fall on the jars. Afterwards I have tried to prove this by a small calculation, bringing into account the declination of the sun during the days of the experiments (11°—13° S. for the first and 7°—10° N. for the second series), the declination of Batavia (6° S.) and the breaking at the water surface. In doing this I came to the conclusion that it may have been possible that the lowest jar in the second series of experiments has fallen within the shadow of the boat for a short time about noon. This cannot therefore have influenced the results to any practical degree. Moreover,

it is doubtful if the shutting off of the direct light would be of any influence at a depth of 18 m, where all light perhaps may be said to be indirect.

I preferred to use sea water with a low initial oxygen content, as the oxygen increase could be considerable then before supersaturation occurred. I therefore always used water from one of the tanks of the Onrust Aquarium, which has a low oxygen tension in the early morning. As this measuring of the oxygen content, filling and closing the jars and their transportation took a long time (1—3 hours), the initial oxygen content as given below is always somewhat too high (the jars were kept in the dark all the while), so that the real production of oxygen has always been somewhat greater than that given by the figures. As may be seen from the figures given below the respiration amounted to about 0.06—0.07 cc. p. l. per hour in the first and about 0.05—0.06 cc. p. l. per hour in the second series of experiments. As the time in question was different in the different experiments, but the same for each jar, I add the figures for the possible amount of respiration during transport, etc. under each experiment. As I observed before GAARDER & GRAN, as well as miss MARSHALL and ORR measure the production and consumption of oxygen per 24 hours, so that the algae consume during a longer time than their production of oxygen lasts, for during the night production stops and consumption goes on. For that reason the compensation point (i.e. the point of equilibrium between consumption and production) is different from that found when one works during the day only. In connection with our problem it is of greater importance to know the compensation point during daylight, as the oxygen made during the day is of little or no use during the night. It goes without saying that, though the difference between the depths of these two compensation points is not important, the compensation point in my experiments must lie a little deeper than the one of GAARDER, GRAN, etc.

One will see that I give the hours of sunshine in percent of the maximal quantity. I owe these figures, as well as those for solar radiation, to the kindness of the staff of the Meteorological Observatory at Weltevreden. The figures for 1929 were recorded (automatically) at Batavia, those for 1930 at the island Kuiper in the Bay of Batavia itself. Whereas the latter figures give the exact data for the place of the experiments, the figures for 1929 may differ from the real values for the Bay. They agree, however, in that there was a more or less covered sky at both places during the experiments of 1929. The figures for solar radiation give the total quantity of d i f f u s e radiation expressed in calories per cm². I also add the diagram for diffuse radiation for one of the days in question.

Production of oxygen in the light at different depths.

First series. Algae: probably *Bryopsis,* with a rich growth of diatoms, and a number of protozoans, wet weight of each portion 2.9 gr.

17 February, 1929.

Between Onrust and Purmerend. Depth of water 10 m. Experiment from

10.45 a.m.—2.45 p.m. Initial oxygen content measured as about 1 cc. (0.81 and 1.20) p. l., but probably higher [1]).

Oxygen consumption before beginning of experiment 0.2 cc. p. l. Sunshine 76% of maximal value, total diffuse radiation 253 cal. per cm^2 (figures for Batavia).

Number of jar	Depth of jar (in m)	Oxygen in cc. p. l.	Increase in oxygen in cc. p. l.	Visibility of Secchi disc.
5	0.75	4.67 (4.66, 4.68)	3.7	
1	3.75	4.4? (4.24, 4.57)	3.4 ?	3 m
2	5.75	3.90 (3.89, 3.90)	2.9	
4	8.75	3.05 (2.95, 3.15)	2.1 [1])	

18 February, 1929.

Between Onrust and Purmerend. Depth of water 10 m. Experiment from 9.— a.m.—2.15 p.m. Initial oxygen content of the water about 2.97 cc. p. l. (2.87, 3.07).

Oxygen consumption before beginning of experiment 0.14 cc. p. l. Little sun, sky covered, now and then cloudless, sunshine at Batavia 76% of maximal quantity, total diffuse radiation 240 cal. per cm^2 there. Sea far from smooth.

2	3.75	4.34 (4.30, 4.37)	1.37	
1	5.75	4.60 (4.57, 4.62)	1.63	3 m
5	8.75	3.22 (3.20, 3.23)	0.25	

20 February, 1929.

East of Hoorn. Depth of water 20 m. Experiment from 8.15 a.m.—12.15 p.m. (12.15—12.45). Initial oxygen content 3.28 (3.26, 3.30). Oxygen consumption before beginning of experiment 0.16 cc. p. l. Windy, sky now and then clouded, sunshine at Batavia 86%, total diffuse radiation 168 cal. per cm^2 there [2]). Sea turbid.

1	9.75	3.84 (3.82, 3.85)	0.56	
2	12.75	3.47 (3.43, 3.51)	0.19	6 m
4	15.75	3.14 (3.12, 3.16)	— 0.14	
5	18.75	2.86 (2.82, 2.90)	— 0.42	

Consumption of oxygen of these algae in the dark.
14 February, 1929 (jar 1).

Time	*Oxygen in cc. p. l.*	*Consumption.*
8.45 a.m.	4.36 (4.31, 4.42)	Consumption in 8.25 hours 0.6 cc. p. l.; content of jar 9.3 l.; total consumption per hour 0.68 cc.
4.30 p.m.	3.76 (3.74, 3.78)	

[1]) In my preliminary paper on this subject I neglected these results because I did not take care that the water, when I filled the jars by means of a siphon, took up no oxygen. I give these observations therefore for what they are worth, especially for completeness sake.

[2]) The number of calories is small here because the experiment began and finished early.

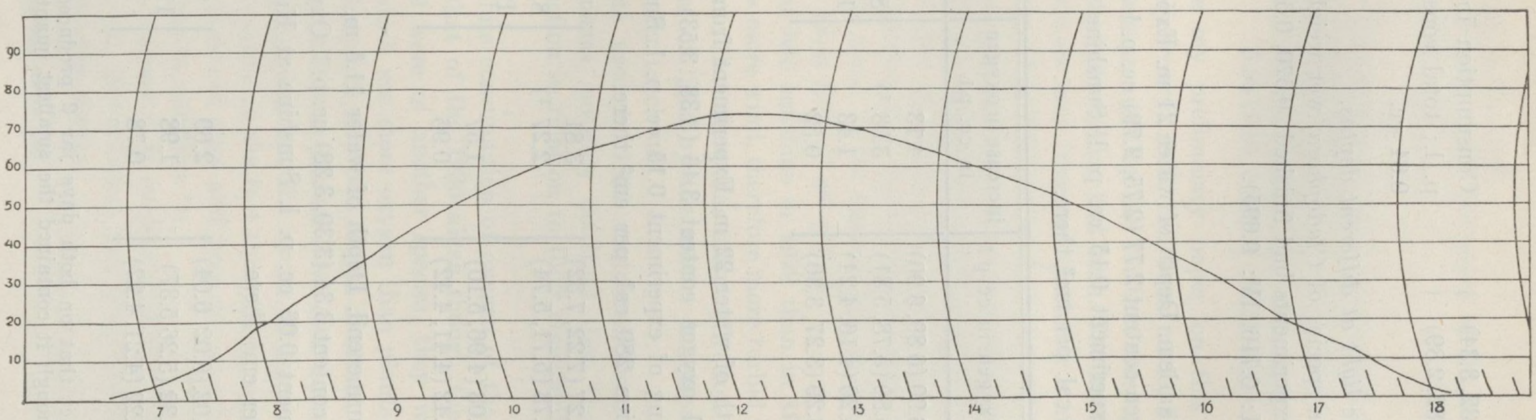

Fig. 2. Quantity of sunshine as measured by solarimetre of Meteorological Observatory, Batavia, at 29 August 1930. The quantity can be expressed in calories per cm² by the use of the formula: (Sum of readings: number of readings) $\times$ time in minutes $\times$ 0,0187. The diagram represents the state of affairs for a bright tropical day with a cloudless sky.

15 February, 1929 (jar 1).

7.— a.m.	3.33 (3.32, 3.34)	Consumption in 7 hours 0.48 cc. p. l.; total consumption per hour 0.64 cc.
2.— p.m.	2.85 (2.82, 2.89)	

Production of oxygen in the light at different depths.

Second series: Algae: a species of *Cladophora,* wet weight of each portion 4 gr, dry weight after the experiments had finished: 0.570, 0.655, 0.695, 0.716 gr (jar I: 0.655, II: 0.570, III: 0.716, IV: 0.695).

29 August 1930.

Between Hoorn and Haarlem. Depth of water 21 m. Experiment from 8.30 a.m.—1.30 p.m. Initial oxygen content 2.77 (2.75, 2.79) cc. p. l. Oxygen consumption before beginning of experiment 0.15 cc. p. l. Sunshine at Kuiper 100%. Total diffuse radiation 368 cal. per cm² there.

Number of jar	Depth of jar (in m)	Oxygen in cc. p.l.	Increase in oxygen in cc. p.l.	Visibility of disc
1	3.—	6.90 (6.89, 6.90)	4.13	
2	8.—	5.80 (5.78, 5.81)	3.03 [1])	8.30: 6.60 m
3	13.—	4.20 (4.16, 4.24)	1.43	1.30: 8.— m
4	18.—	3.29 (3.27, 3.30)	0.52	

3 September 1930.

N.W. of Haarlem. Depth of water 22 m. Experiment from 8.40—12.45 (jar I from 8.20—12.45). Initial oxygen content 3.46 (3.38, 3.53) cc. p. l. Oxygen consumption before beginning of experiment 0.15 cc. p. l. Sunshine at Kuiper 100%. Total diffuse radiation 289 cal. per cm² there.

4	3.—	7.27 (7.22, 7.32)	3.81	
3	8.—	5.73 (5.71, 5.74)	2.27 [1])	8.15 a.m. and 12.45 p.m.: 11 m
2	13.—	5.03 (4.96, 5.10)	1.57	
1	18.—	4.42 (4.41, 4.42)	0.96	

4 September 1930.

Between Onrust and Purmerend. Depth of water 11.5 m. Experiment from 7.15 to 11.15. Initial oxygen content 3.34 (3.30, 3.38) cc. p. l. Oxygen consumption before beginning of experiment 0.06 cc. p. l. Sunshine at Kuiper 98%. Total diffuse radiation 178 cal. per cm² there.

3	3	6.03 (6.02, 6.04)	2.69	7.15 a.m.: 7.3 m
2	6	5.32 (5.26,5.37)	1.98	11.15 a.m.: 4.— m
1	9	4.22 (4.21, 4.22)	0.78	

[1]) It is a remarkable fact that on both days jar 2 produced more oxygen at a certain depth than jar 3, though it contained the smallest quantity of algae.

Oxygen consumption in the dark.

The oxygen consumption of the algae of the second series of experiments gave the following figures:

4 September 1930.

jar 3:	1.50 p.m.	5.75 (5.74, 5.76)	Consumption in 2 hours 0.12 cc. p. l.;
	3.50 p.m.	5.63 (5.61, 5.65)	total consumption per hour 0.56 cc.
jar 2:	1.50 p.m.	5.75 (5.74, 5.76)	Consumption in 3.5 hours 0.19 cc. p. l.;
	5.15 p.m.	5.56 (5.54, 5.57)	total consumption per hour 0.50 cc.

When I gave my preliminary paper on this subject after the oxygen measurements of February, 1929, had been made, I had not yet seen the fine paper of miss MARSHALL and ORR and for that reason did not sufficiently realize how gross my method of working had been. The hours of sunshine had not been recorded, the algae were very "unpure" (probably a mixture of *Bryopsis,* diatoms and a rich vegetation of protozoans) and moreover I made the mistake of rounding off my figures, without there being any obvious reason for it. Finally my end conclusion, that the compensation point would lie about 7—8 m deeper than the limit point of disc visibility, was based on two observations only. It is therefore little astonishing that the few results of the second series of experiments were different from those of the former. For in comparing the results of both series the data at hand first of all tell us:

1. that there was less sunshine in 1929 than in 1930;
2. that there was more wind, therefore more turbid water and more silt in 1929 than in 1930, so that there was more reflection of light at the surface and more dispersal of light by the matter in suspension.

The data further teach us:

1. that the algae used in 1929 contained more non-assimilating products (animal organisms, possibly detritus) than those of 1930, so that their oxygen production in relation to their consumption must have been somewhat smaller;
2. that the absolute consumption of oxygen of the 1929 algae was somewhat higher than that of the 1930 algae though the latter weighed more (the algae of 1929 were of another species, they were unpure and contained protozoans, which use more oxygen than plants).

But finally there is a very bad source of errors: the portions of algae were weighed wet and it was shown later (see above) that the weight of the different portions was not the same. Moreover miss MARSHALL and ORR have called attention to the fact that young cultures of *Coscinosira* produce more oxygen than old ones and here we do not know anything about the age of the algae in question [1]).

For all these reasons it is evident that the value of my figures becomes greatly restricted. Nevertheless the compensation point may be found to lie at the following depths.

[1]) See foot note on page 192.

	Neighbourhood of Hoorn and Haarlem (depth of sea 20—22 m)		Neighbourhood of Onrust (depth 10 — 11.5 m)	
	Limit point of disc visibility	Compensation point	Limit point of disc visibility	Compensation point
1929, February 18 th.			*3*	9.5 — 10.5
20 th.	*6*	14.5		
1930, August 29 th.	first 6, later *8*	19 — 20.5		
September 3 rd.	*11*	20 — 25.5	first 7.3, later *4*	10 — 12
4 th.				

Putting it in another way we find the following:

Disc visibility	Compensation point
3 m	9.5 - 10.5 m
4 „	10 — 12 „
6 „	14.5
8 „	19 — 20.5 „
11 „	20 — 25.5 „

It follows from these figures, when they are compared with those of table X, that in clear water the compensation point in the Bay of Batavia may lie near the bottom. It may then even lie a little *below* the bottom, i.e. there is production of oxygen at the bottom then. On the other hand it lies much higher when the water is opaque and as this is the rule during many days (even weeks) especially in the westmonsoon [1]) we may be sure that the mean value for the depth of the compensation point lies several metres above the bottom. It goes without saying that a larger number of observations is necessary if we wish to get more exact figures; these few observations, however, may suffice for the moment.

I refrain from comparing these few results with the ones already existing, especially with the valuable figures of miss MARSHALL and ORR. But we see that even in the tropics, so close to the equator, and even in a coral reef region, we need not always have the blue clear water one dreams of in thinking about reef formation. MARSHALL and ORR (1931, p. 123) already called attention to the same fact in relation to the lagoon inside the Australian Barrier reef.

I should like to emphasize once more that my supposition, the compensation point is to be found 7—8 m below the limit point for disc visibility, is wrong. The question is of great interest in connection with ecological studies and the work should be completed through exact photoelectric measurements.

[1]) It follows from the experiment of February, 20, 1929, that at 18.75 m depth there was a consumption of oxygen of 0.42 cc. p. l. in 7 hours; that means that the total consumption per hour amounted to 0.60 cc. And as flask 1 consumed per hour 0.68 and 0.64 cc. there was at 18.75 m no oxygen production at all, i.e. no light.

5. DEPTH OF THE LIVING REEF.

The only question which remains to be studied concerns the depth of the living reef.

The method of working was very simple. Using the diving helmet I went down the slope of the reef at the northern side of the island (where the reef descends deepest) and having reached the limit of coral growth at the margin of the layer of limy mud I veered out my rope (divided into metres) and bamboo until the bamboo had reached the surface. In this way the depth between surface and lowest corals could be accurately measured. The measurements were reduced to low spring tide and rounded off to half metres. These observations, made in August, 1930, gave the following results.

Island	Depth of living reef in m	Depth of sea in m
Onrust	7 — 7.5	9 — 10
Kerkhof	8	10 — 12
Rotterdam	10	14 — 16
Hoorn	12	16 — 20
Haarlem	15	20 — 22

I must add at once that at all these reefs some few species of corals only reach these depths and that most species do not reach below 5—8 m; I hope to deal with this question in a following paper, however.

A glance at the figures shows that the living parts of the reefs descend deeper, as we go farther away from the coast, but that the depth of the sea increases faster than the reef depth, so that the difference between the depth of the living part of the reef and the depth of the surrounding sea increases away from the coast. At Kerkhof the sea is about 3, at Haarlem about 7 m deeper than the living reef. This in itself is a quite interesting problem, for one may ask how these reefs developed from the bottom. As I hope to treat this question in a following paper, however, we may for the moment pass on to our conclusions.

FINAL CONCLUSIONS.

We have seen that the oxygen consumption of a coral reef is very great, not to say enormous. Currents are therefore of vital importance to the development of reefs. Where they fail, the reef may be greatly hampered by lack of oxygen from this cause alone. For such a reef light may be assumed to be a limiting factor as to depth. But it is quite probable that for several other reasons too a coral reef needs a large amount of light. We therefore have tried to show whether there would perhaps exist a direct relation between the depth of the living reef and the average depth of light penetration round about that reef. The existence of such a correlation would be a very strong argument in favour of the relation between reef depth and light influence.

We have shown that the silt quantity greatly influences the light penetration as measured by the oxygen production of algae at different depths and that the light for that reason penetrates much deeper near Hoorn and Haarlem than near Onrust, where the silt quantity is so very great. When dealing with the visibility of SECCHI's disc we have seen that the depth of the sea, in going away from the coast, increases faster than the disc visibility. In precisely the same way we have found that the depth of the sea, in going away from the coast, increases faster than the depth of the living reef. This shows that there exists a neat correlation between the silt quantity and the reef depth. And as the silt quantity is a measure for the (reduced) penetration of light, there is a neat correlation between light penetration and reef depth.

One could object that not the light, but the silt itself, is of prime importance here, and that the Onrust corals are killed by the large quantities of silt below 7 m, whereas those at Haarlem are killed by the silt below 15 m only [1]). This cannot be the case, however. I have pointed out in my former paper (1930, p. 309—310 and p. 353) that the quantity of silt on one and the same reef decreases with increasing depth of the water, because this quantity greatly depends on wave action. And that several clear water forms, which at Haarlem live near the surface, at Hoorn live in deeper water only. For that reason the influence of falling silt is more bad at smaller than at greater depth and the fact remains that there is a neat correlation between light penetration and reef depth. As stated before this means a very strong argument in favour of the dependence of coral reefs on light.

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[1]) It was WOOD-JONES (1912) who assumed sedimentation of silt to be the limiting factor as to reef depth. He believed that at greater depths the currents are not capable of carrying sediment in suspension and that therefore the corals there are subjected to a constant raising of it.

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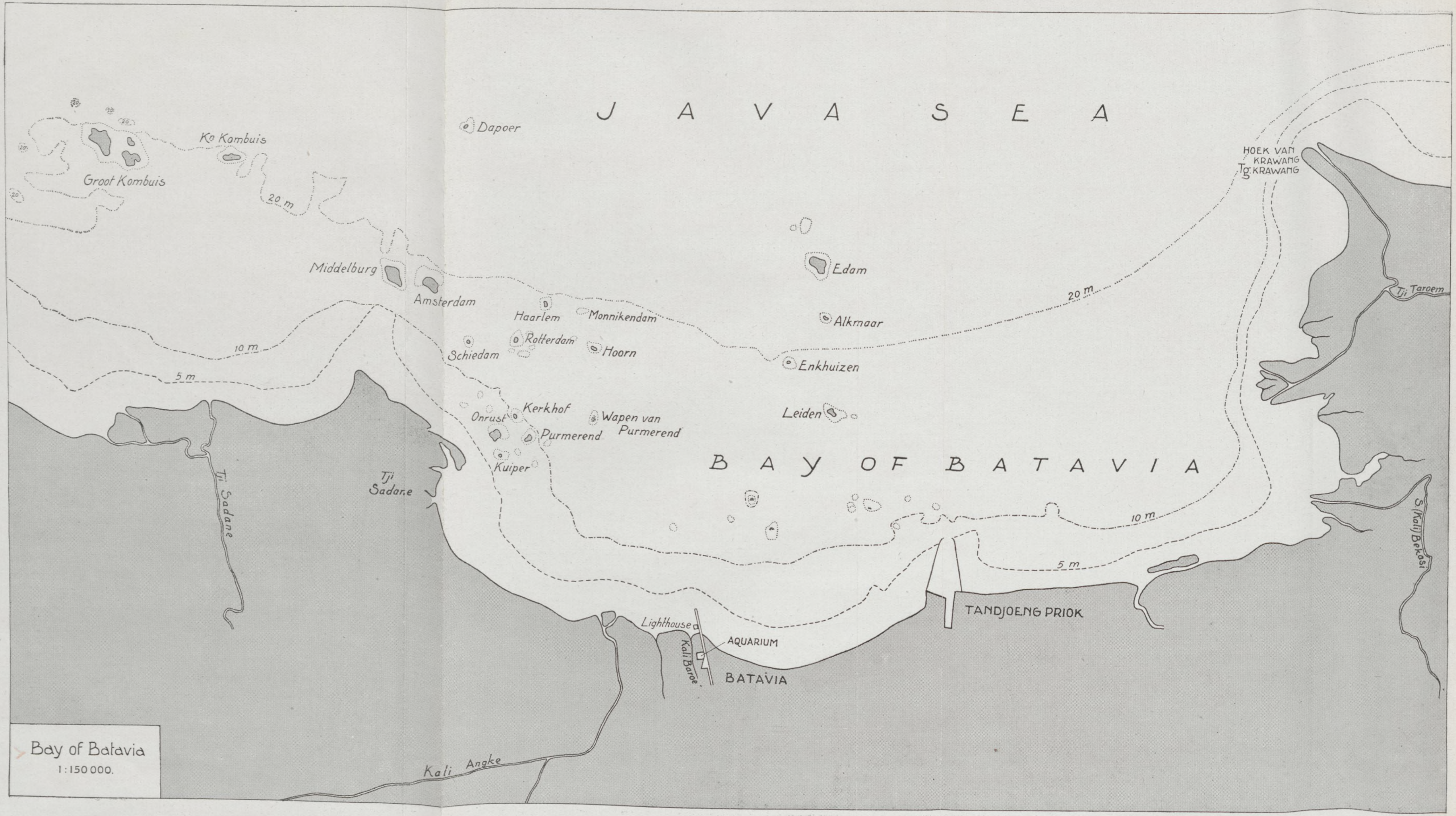

Bay of Batavia
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CORAL REEF STUDIES.

III. GEOMORPHOLOGICAL NOTES ON THE CORAL REEFS OF BATAVIA BAY.

By

J. VERWEY.

(Laboratorium voor het Onderzoek der Zee, Batavia).

Introduction.

The formation and geomorphology of the reefs of Batavia Bay and the Thousand Islands has been fully dealt with by Umbgrove. When he left Java for Europe, his work left us with a number of interesting problems. It was therefore difficult not to keep an open eye to geomorphological questions during the ecological survey of the reefs in question. This survey could be extended to somewhat deeper water through the acquisition of a diving helmet and in this way some geomorphological observations of much interest have been collected. On the other hand the observations in this direction never became more than casual ones, made during other work. And thus these notes should be considered in this light, coming from a non-geologist, who became stimulated through his friend's enthusiasm and energy.

The survey, and therefore the notes, refer especially to three islands: 1. Pulu dapur [1]), 2. Pulu damar besar or Edam, 3. Pulu aier besar or Hoorn. Of these islands Pulu dapur (see map) is lying farthest from the coast and may be mentioned as a good example of a Thousand Islands reef, Hoorn is lying nearest to the coast and represents a typical reef of the Bay of Batavia; whereas Edam takes an intermediate position.

Accordingly the meteorological and hydrographical conditions under which these islands live differ somewhat for the three islands. The sea near Dapur has a depth of about 30 m, near Edam it has a depth of 25 m, near Hoorn of only 20. At Dapur the surf is formed by the long rollers from the open Java Sea, which cause a rather heavy swell. There is a distinct system of land and sea winds, but judging from personal observations this is of less importance than nearer the coast. There can be little doubt that currents are stronger than in the Bay of Batavia. — At Hoorn the long rollers from the open sea

[1]) The malayan word dapur means kitchen; pulu means island; damar means resin, but also torch (Edam possesses a lighthouse); aier means water; besar means great. The dutch names refer to the towns Edam and Hoorn in Holland; even Rotterdam and Amsterdam are to be found in or near the Bay of Batavia!

have greatly lost their strength; there is generally a great difference in swell between some distance nörth of Haarlem and the sea south of this island. Therefore Hoorn is washed by much shorter waves. The land and sea wind system is strongly developed and the water flows less fast, both factors working together to cause strong sedimentation along the south side. This sedimentation is moreover increased by the shallowness of the sea and the neighbourhood of the coast with its riverdelta's. — Edam finally, in all these respects, takes an intermediate position.

Another difference lies in the influence of western winds in- and outside the Bay. The Bay islands, but especially the ones investigated, occupy the western half of the Bay. Onrust, Purmerend, Kerkhof and, in a lesser degree, Hoorn are therefore more or less protected against western winds (see map), whereas they are more open to winds from eastern directions. On Edam, however, lying outside the Bay, western winds act with full force. This means that Edam, like the Thousand Islands proper, is influenced quite differently during the two monsoon periods, whereas this different influence is less great for the islands nearer the coast.

These facts have to be born in mind when the following pages are read.

2. GROWTH AND MOVEMENT OF REEF AND ISLAND.

"The reefs themselves are rooted in the muddy bottom of the Bay. SLUITER relates in his description, as early as 1890, how numerous hard objects, shells, and especially pieces of pumice stone, lie scattered all over the floor of the Bay and form a convenient formation for the beginnings of a coralreef" (UMBGROVE, 1929a, p. 5). I shall take this reef, growing up from the bottom, as our point of departure.

The composition as regards the number of species of such a reef at somewhat greater depth is very uniform. The number of corals, growing some fifteen metres below the surface in the Bay of Batavia, is small. We have seen in a former paper of this series that the silt quantity in the Bay of Batavia is so great as to materially influence the penetration of light into the water. That is the reason why all species, which need a greater quantity of light, do not occur at somewhat greater depth, their limit on the different islands depending on the silt quantity and therefore on the neighbourhood of the coast. The whole genus *Acropora*, e.g., does practically not occur below 8—10 metres and its optimum conditions are to be found between low tide level and 5 metres depth. — Most corals, growing at some distance below the surface, grow upward much more than sideward. It is of common knowledge that many species of corals in deeper water show a habitus different from the one they show near the surface, as they strive upward towards the light. And as they will strive upward faster the less strong the light, the result must be that upgrowth at somewhat greater depth is greater than near the surface. That this is really the case is proved by observations on the growth of a large number of reefs over

a long period, recently published by VERSTELLE. They were calculated from two issues of Sea Chart No. 60 of the East Indian Navy (Gulf of Tomini, Celebes), the first of which was based on survey work in 1898—99 and 1905, the second on work in 1930.

As VERSTELLE's notes were published in dutch, I quote them in full here [1]:

„The reefs were divided into 3 groups, viz., reefs which during the first survey were covered by less than 3 m of water, reefs which were covered by 3-5 m of water and reefs, the depth of which was more than 5 metres. All values have been reduced to low tide level.

In the part surveyed by the „Borneo" 68 reefs, all living in 1930, were available for comparison. On 17 reefs as much water was found in 1930 as in 1905 or even more; this might be an indication of sinking. These 17 reefs were not used, so that 51 remain.

The results of this comparison follow below:

Depth in 1905.	Number of reefs.	Average growth in 25 years.	Minimum growth in 25 years.	Maximum growth in 25 years.	Average growth p. annum.	Number of years of the comparison.
less than 3 m	28	1.08 m	0.25 m	3.— m	4.3 cm	25
3-5 m	7	1.67 „	0.75 „	3.75 „	6.7 „	25
more than 5 m	16	2.38 „	0.50 „	9.— „	9.5 „	25

In the part surveyed by the „Java" 42 living reefs were available for comparison. 8 reefs could not be used for the same reason as given above, so that 34 remained. The results of this comparison were:

Depth in 1898-99.	Number of reefs.	Average growth in 32 years	Minimum growth in 32 years.	Maximum growth in 32 years.	Average growth p. annum.	Number of years of the comparison.
less than 3 m	4	1.12 m	0.25 m	2.25 m	3.2 cm	32
3-5 m	12	2.27 „	0.25 „	3.75 „	7.1 „	32
more than 5 m	18	3.38 „	0.25 „	13.25 „	10.5 „	32

Both sets give a very good agreement. Their average values are:

depth less than 3 m: growth p. annum 4.2 cm, max. 16 cm (32 observ.);
„ from 3 to 5 m: „ „ „ 7.— „, „ 15 „ (19 „);
„ more than 5 m: „ „ „ 10.— „, „ 41 „ (34 „).

These valuable observations show that reefs in the East Indies below 5 m may grow up as much as 10 cm per year. And though it is not probable that those coral species which live at a greater depth (30-40 m) grow as rapidly as the species which live just below 5 m, 10 cm may be a good average value for reefs of all depths, as the maximum upgrowth is much greater still. Thus a reef lying at a depth of 40 m would need only 400 years to reach the surface, an estimation lower than all previous ones.

[1]) Since I finished this paper VERSTELLE wrote a more detailed account, in which a number of other reefs have been included. It will appear in Treubia.

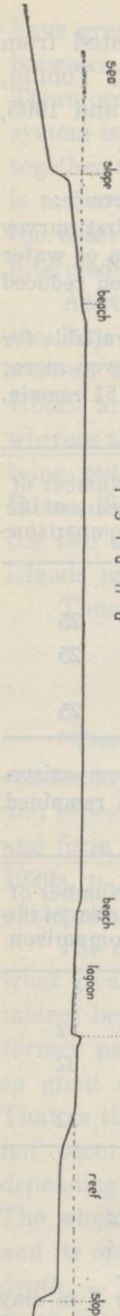

Fig. 1. North south section through the island Hoorn, Bay of Batavia. Scale 1 : 2500.

When the reef has grown up to 5 metres below the surface, conditions of life begin to change gradually but effectively. The reason is that the reef is beginning to form its own surf and swell. To make this clear I first give a diagrammatic sketch of a cross section through a reef of the Bay of Batavia (fig. 1). Information as to conditions in the deeper parts were got through the use of the diving helmet.

The diagram represents a north-south section through a part of the island Hoorn in the Bay of Batavia. The distance from the southern beach of this island to the outer slope of the northern shingle wall is in this part about 270 m (see also fig. 3). Between the sand island itself and the shingle wall just mentioned a small very shallow lagoon conducts outward the water, thrown over and coming in through breaks in the shingle wall during high tide. The outer side of the shingle wall slopes very gradually to a depth of about 5 m. After this depth has been reached, the depth remains constantly 5 m for a long way, several tens of metres; but this length was never accurately measured. Then a point is reached where the slope becomes steep and it remains so from 5 to 12 m depth (measured vertically). There all coral growth ceases rather abruptly and a limy mud covers the bottom and makes all working impossible as it is brought into suspension and prevents one's seeing anything. — The south side of the island slopes gradually to a depth of about 3 m, when the slope falls very abruptly to deeper water, the plateau of uniform depth of about 5 m failing altogether. The corals at the south side inhabit the upper edge of the steep slope and the shallow part between the latter and the beach. The steep slope goes down to a depth of 10 m, when the bottom becomes irregular and nearly horizontal; the slope consists of bare sand. — As all coral growth at Hoorn ceases below 12 m and the depth of the surrounding sea is 16—20 m, it is probable that the lower part of the steep slope north and south (as well as east and west) of the island, reaches gradually that depth.

How did the plateau just mentioned, at a depth of about 5 m, come into existence? To understand this, let us return to the reef which has grown up to about 3—5 m below sea level, for which I refer the reader to diagram b, fig. 2.

There are several such reefs in the Bay of Batavia. These reefs show to their southwestern side a sandplate, with hardly any coral growth, to their northern or northeastern side coral colonies, turned over and loosened by the swell of the waves. Those who read UMBGROVE's studies will understand that

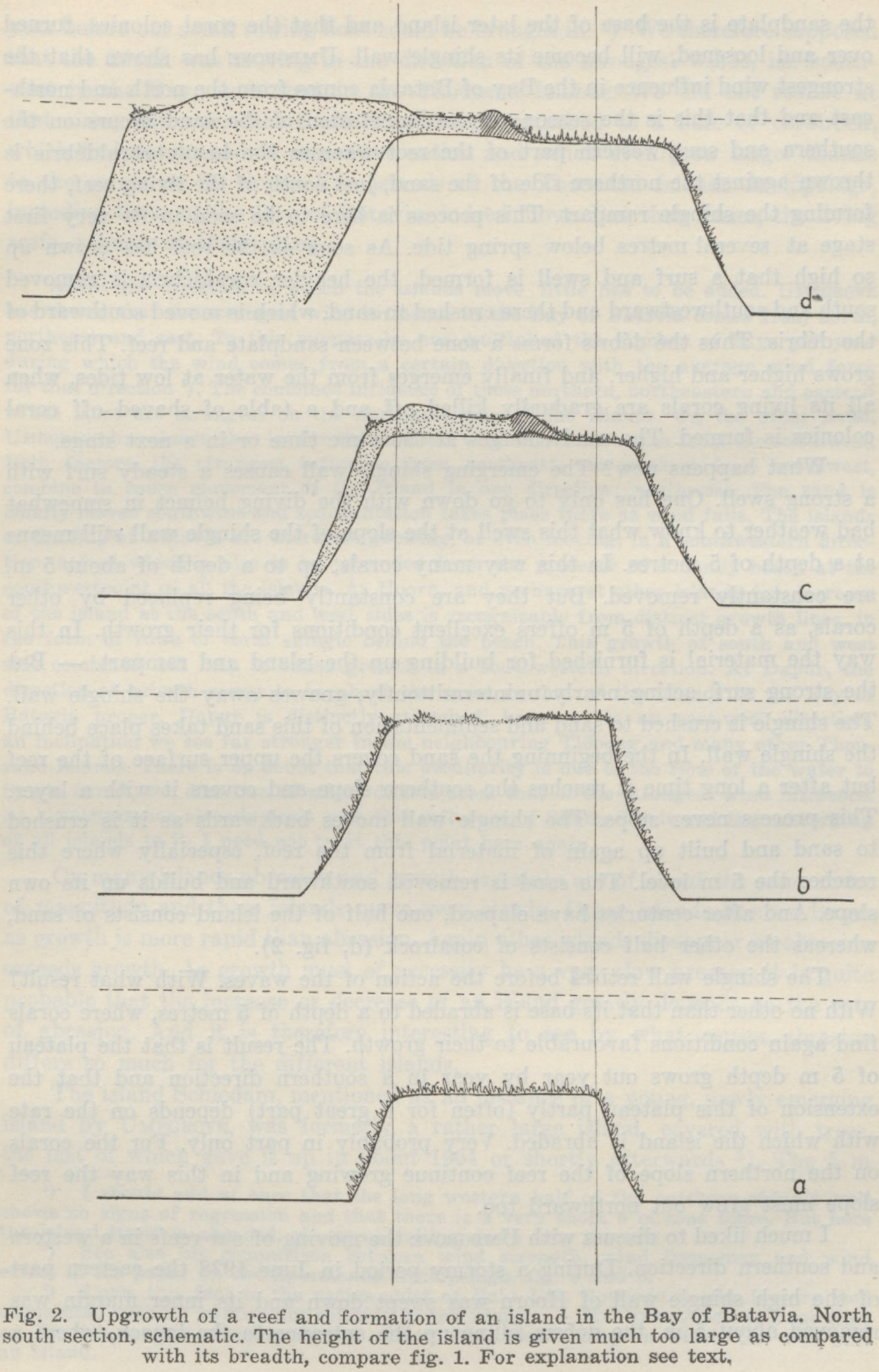

Fig. 2. Upgrowth of a reef and formation of an island in the Bay of Batavia. North south section, schematic. The height of the island is given much too large as compared with its breadth, compare fig. 1. For explanation see text.

the sandplate is the base of the later island and that the coral colonies, turned over and loosened, will become its shingle wall. UMBGROVE has shown that the strongest wind influence in the Bay of Batavia comes from the north and northeast and that this is the reason why sedimentation of the sand occurs on the southern and southwestern part of the reef whereas the heavy coraldébris is thrown against the northern side of the sand, just south of the living reef, there forming the shingle rampart. This process is here to be seen in its very first stage at several metres below spring tide. As soon as the reef has grown up so high that a surf and swell is formed, the heavier coraldébris is removed south and southwestward and there crushed to sand, which is moved southward of the débris. Thus the débris forms a zone between sandplate and reef. This zone grows higher and higher, and finally emerges from the water at low tides, when all its living corals are gradually killed off and a table of shaved off coral colonies is formed. The sand emerges at the same time or in a next stage.

What happens now? The emerging shingle wall causes a steady surf with a strong swell. One has only to go down with the diving helmet in somewhat bad weather to know what this swell at the slope of the shingle wall still means at a depth of 5 metres. In this way many corals, up to a depth of about 5 m, are constantly removed. But they are constantly being replaced by other corals, as a depth of 5 m offers excellent conditions for their growth. In this way the material is furnished for building up the island and rampart. — But the strong surf, acting nearly unintermittently, gnawes away the shingle wall. The shingle is crushed to sand and sedimentation of this sand takes place behind the shingle wall. In the beginning the sand covers the upper surface of the reef but after a long time it reaches the southern slope and covers it with a layer. This process never stops. The shingle wall moves backwards as it is crushed to sand and built up again of material from the reef, especially where this reaches the 5 m level. The sand is removed southward and builds up its own slope. And after centuries have elapsed, one half of the island consists of sand, whereas the other half consists of coralrock (d, fig. 2).

The shingle wall retires before the action of the waves. With what result? With no other than that its base is abraded to a depth of 5 metres, where corals find again conditions favourable to their growth. The result is that the plateau of 5 m depth grows out year by year in a southern direction and that the extension of this plateau partly (often for a great part) depends on the rate with which the island is abraded. Very probably in part only. For the corals on the northern slope of the reef continue growing and in this way the reef slope must grow out northward too.

I much liked to discuss with UMBGROVE the moving of our reefs in a western and southern direction. During a stormy period in June 1928 the eastern part of the high shingle wall of Hoorn was swept down and its inner margin was removed about 5 m, the débris filling up the entrance to the lagoon, where a

year before our small rowing boat could be brought in. [1]) We therefore supposed that the island was moving in the direction of the strongest winds, i.e. southwest in the Bay, more west in the Thousand Islands. We did not realize at that time, however, that these islands were attached to a base of coralrock, which had not to endure any wave action and which even grew larger thanks to the corals on its slopes. The islands of the Thousand Islands Archipelago, including those of the Bay of Batavia, indeed move. But their bases, the living reefs, remain at their place.

About the direction in which the islands move little has to be added. UMBGROVE has shown that the strongest wind influence in the Bay of Batavia comes from north, northeast and east. To this purpose he has multiplied the number of days per year during which the wind comes from a certain direction with the average wind force for that direction [2]). The combined influence of these northern, northeastern and eastern winds must act strongest on the northeast side of the islands. On the other hand, UMBGROVE has shown that by far the smallest wind influence comes from the southwest. Both factors, the strongest influence from northeast, the weakest from southwest, combine to cause movement of the island in one direction: southwest. The sand is chiefly moved southwest and sedimentation takes place there as wind fails. The islands of the Bay of Batavia are therefore growing, or even moving, in a southwestern direction, a fact which is also to be concluded from the presence of a sandy beach at the southwestpoint of all the islands. At Hoorn, and perhaps at other islands too, increase of the island at the south and west sides is recognizable from distinct growth lines, in the form of rows of coral shingle behind the beach. This growth of south and west side combined will help to cause growth in a southwestern direction. At Dapur, the direction of growth seems to be about the same as that of the islands in the Bay of Batavia proper. Dapur is distinctly stretched, however, in an east-west direction, an inclination we see far stronger in the neighbouring Tidoeng and many other Thousand Islands. There is no doubt that this peculiarity is due to the flow of the water to Sunda Strait, the direction of which differs from that of the strongest wind influence. As UMBGROVE has already dealt with this influence of Sunda Strait and the converging of all islands to it I need not treat this point here again.

On many islands abrasion and growth certainly are of about the same order of magnitude and these islands move very slowly. Other islands become larger as growth is more rapid than abrasion. Again other islands disappear as abrasion exceeds growth. As growth must of necessity be a very slow process, it is quite probable that the increase or decrease of an island greatly depends on the rate of abrasion. And it is therefore interesting to see by what causes abrasion differs so much for the different islands.

The island Schiedam, mentioned as an instance of a young, newly emerging island by UMBGROVE, was formerly a rather large island, covered with trees, the last of which gave it up in about 1904 or shortly afterwards [3]). The 5 m

[1]) I should add at once that the long western half of the northern shingle wall shows no signs of regression and that there is a very short 5 m zone there. But here the island itself is abraded, the trees falling down into the sea.

[2]) See also his comparison between wind strength, wind frequency and wind effect in his paper on the Spermonde Archipelago, fig. 5 and 6.

[3]) I owe this fact to the native chief of Pulu Ubi, Rotterdam, who is very well acquainted with all particulars relating to the islands. — Mr. STEINFURTH told me that an English captain, visiting Onrust about 1920, used a map on which Ubi was still an island.

plateau is very extensive on this island, as also holds for Rotterdam. — The island Rotterdam is rapidly abraded at its north side, whereas it grows little on its south side. The island is rapidly decreasing in size. — The reef Vader Smit between Batavia and Tandjong Priok (Batavia's harbour), not reaching low tide level now, was formerly a sand plate, as it is mentioned as such on a map in DE MARRE (1723) [1]). And perhaps was it a fine island still earlier back! — I got the impression that Haarlem too is disappearing, but this impression needs confirmation. I do not know whether the islands Hoorn and Purmerend decrease much in size; abrasion is of much importance there. The growth at the south side of Purmerend is evident from the fact that a native boat, sunk below the stair at the south side, was still visible in 1922 and had disappeared below the sand in 1928 or earlier [2]). The stair itself, which dates from long ago, has become greatly hidden below the sand.

Now, the chief of Pulu Ubi, Rotterdam, ascribes the rapid abrasion of the islands of Batavia Bay, as it takes place since a number of years, to the destruction caused to the reefs by men fetching corals for the streets of Batavia. Everywhere in the Indies corals are freely used for road making, this being a very old practice already, as the walls of the town of Batavia, built just before 1640, were partly constructed of corals (DE HAAN, I, p. 552 and 323).

At first sight it may seem impossible that such a destruction should be of any importance to the reefs. One has to know, however, that the fleet of Batavian coral boats now numbers more than 40 (counting a total of more than 200 men engaged in the work), and that one boat, containing about 3 cubic m, is filled in 1—2 days. Assuming that the boats return every five days, this would make a total of about 8500 cubic m of corals in a year [3]). And as the species of corals sought for are especially the massive species of *Porites, Favia,* etc., in the very first place *Porites lobata,* which forms the stronghold of the reef, there is little doubt that Pulu Ubi's chief is right. *Porites lobata* grows along the lower edge of the upper reef slope and especially on the plateau of 5 m depth, described above. Here these enormous, massive colonies, which may have a diameter of 3 m and more and a height of from 1 to 4 m, form a breakwater of very first importance, the value of which should not be underestimated. Where man succeeds in breaking down these masses (even dynamith is used) the surf gets free play and the waves act with full force on the shingle walls. As these colonies need a long time to reach their large size destruction has proceeded far before they have grown up again. Moreover, where the surf is strongest, these colonies of *Porites,* together with the reef between them, may have died altogether and when then they are broken away they can never grow up again, conditions being too unfavourable.

[1]) I owe these particulars to Dr. S. W. VISSER, acting director Meteorological Observatory, Batavia.

[2]) I owe these particulars to Mr. STEINFURTH, Onrust.

[3]) On 25 May, 1931, I taxed the quantity of corals, ready for use at the southwestern margin of the town of Batavia, at between 6000 and 7000 m^3. According to this taxation a total of 20 to 40 thousand m^3 of corals may have been brought to Batavia in the years 1928-1930.

2. SHINGLE WALL, LAGOON, REEF SLOPE.

After having dealt with the appearance and disappearance of the island as a whole there remain a few points to be treated in somewhat more detail. They concern the shingle wall, the lagoon and the reef slope.

It follows from the above statements that UMBGROVE's supposition, a bare sandplate represents a young island, does not hold. For such an island can very well be a disappearing one [1]. A second assumption of UMBGROVE was that the absence of a lagoon between shingle wall and island was evidence of a long history of the island in question. The shingle wall, however, tells us as little about the history of the island as the contradiction sandplate-green island. It is nothing more but the more or less immediate product of forces acting at the present moment. The shingle walls in general consist of very high parts with low ones between. Now there is a rather neat correlation between the state of the reef and the height of the neighbouring part of the shingle wall. The highest parts of the shingle wall bound that part of the island where wave influence is strongest. This is also the part where the strong swell has killed the reef and where the latter begins in somewhat deeper water, at some distance from shore. And just because the reef fails and the waves reach the shingle wall with unbroken force, the shingle wall there is thrown up to such a height that it looks like a minute mountain range on a flat plain. — When a long stretch of island resists the sea a distinct lagoon channel has to conduct the water entering the breaks of the shingle wall during high tides. But when the island becomes small by abrasion, especially on its northeastern side, the water may no longer need a lagoon channel and I believe that under such conditions the shingle wall may be swept out and become a flat stretch of coral débris as is also found at the eastern extremity of the northern shingle wall on nearly all the islands investigated. — Superficial observation of the action of the waves on the shingle wall during bad weather teaches much about the why of the configuration of the shingle wall. Especially observations at Hoorn gave interesting details (fig. 3 and Plate 2).

Hoorn provides us with a very typical example of low and high parts of the shingle wall, of changes in the configuration of the wall in consequent years and of a very fine lagoon channel with a number of inflows or outlets. I stated already that at the northeastern side of the island the strong surf prevents the living of the reef in shallow water, so that the surf there acts with full force on the shingle wall, which retires before it. Along the western half of the north side,

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[1]) MOLENGRAAFF (1930, p. 69), following VAN VUUREN, assumed in the same way that the outermost islands of the Spermonde shelf were younger than the more inward ones, because they were lower. It is quite possible that they are much younger, but this may certainly not be concluded from their size. It may be that the more outward reefs do not become islands as they have to resist a too strong surf. Many such instances can be cited. Compare also the remarks of UMBGROVE (1930 b, p. 243) on the reefs studied by KREMPF (1927).

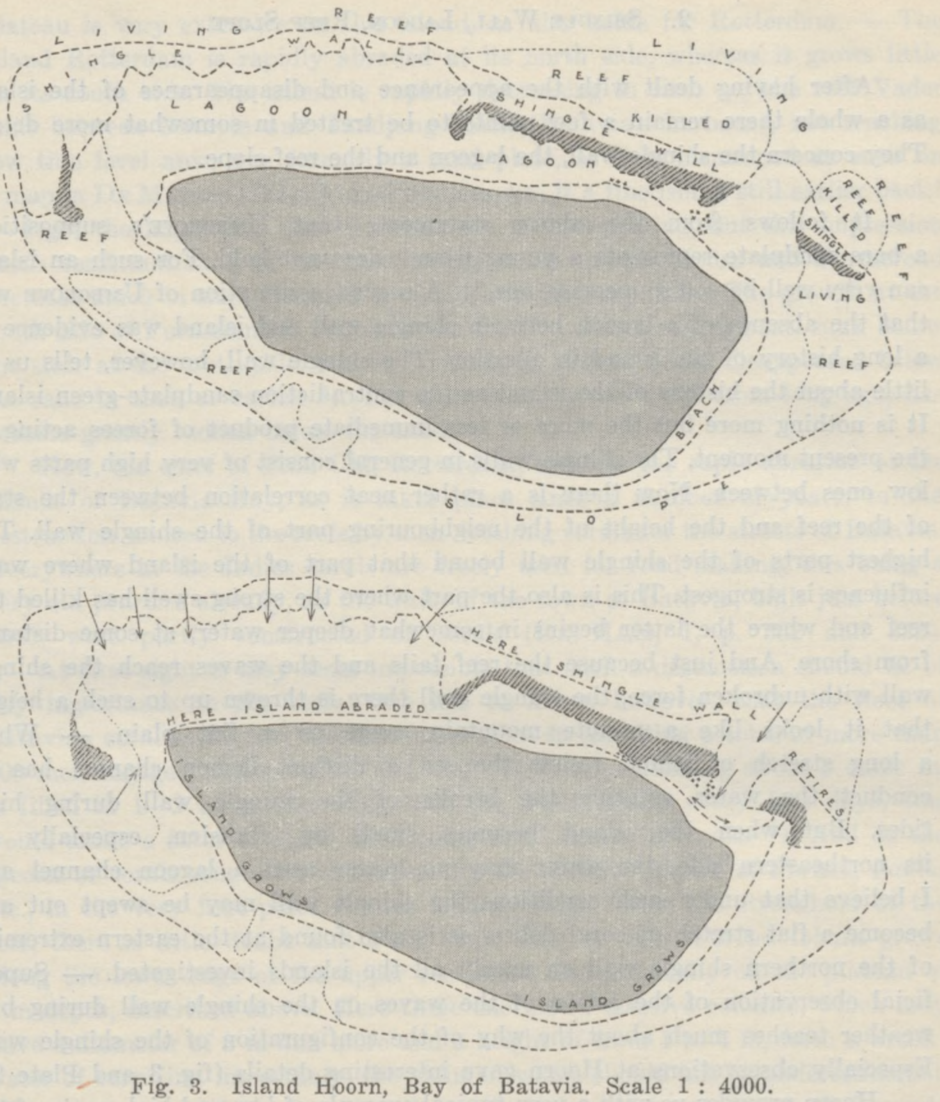


Fig. 3. Island Hoorn, Bay of Batavia. Scale 1 : 4000.

a. The island in August 1927, after photograph of Military Air Service, reproduced by UMBGROVE (1928).

b. The island in August 1930, after survey of the author.

Comparison of figs. 3a and b shows the changes which have taken place in 3 years. The high eastern half of the shingle wall has retired before the action of the waves, filled up the eastern entrance to the northern lagoon and is now covering the mangrove trees. For further explanation see text.

The arrows denote the gaps in the shingle wall, the crosses are mangrove trees.

however, the surf is less strong, the reef can grow in shallow water and thus protect the shingle wall, which is low there. But the surf now beats the island, so that the latter is abraded.

The island was photographed in August 1927 by the Military Air Service. This photograph, together with those of other islands, was reproduced by

UMBGROVE, and served as a model for fig. 3a. Half a year later I visited the island for the first time. Near E there was a channel between the mangrove trees and the shingle wall, through which our small rowing boat could enter the lagoon. In June 1928, during bad weather, the shingle wall was swept down and part of the channel filled with coral fragments, a change I stated on June 19—22. On July, 10—13, the shingle had nearly reached the trees and there was no question about entering the lagoon between trees and shingle. This process has since gone on. The map, here reproduced, fig. 3b, was made after measurements on August 20, 1930. Comparison of figures 3a and b may serve to show the great changes which have taken place. In April, 1931, the small mangrove trees stood no longer free at the edge of the shingle, but were growing in the wall. It should be added, that this rapid erosion since 1928 is doubtless due to the destruction of all massive dead *Porites* along the northeastern side of the island, where the reef had been killed by the surf.

An interesting point as to the configuration of the shingle wall is formed by the strong bends at the edges of the high parts of the wall, which are e.g. to be found near B and C in fig. 3. They are due to the action of the water which enters the lagoon through the neighbouring breaks in the shingle wall. — The eastern part of the shingle wall, which in 1928 still was without connection with the island itself, since 1930 is connected with it through a sandridge, which has been formed through the water, entering the lagoon at A, reaching the beach at *a* and flowing off to the right and left. — Such and other observations demonstrate quite ordinary facts; but they may help to emphasize more clearly the fact that the configuration of the shingle wall cannot be used for helping to understand the history of the island.

In close relation to the place and configuration of the shingle wall stands the rôle played by the lagoon. The typical Bay islands, which all have their shingle wall from northwest via north to east, have their lagoon also to this side of the island, Hoorn, Kerkhof and Purmerend being good instances. Farther from the coast, however, conditions change. I stated in the Introduction already, that the influence of western winds becomes more marked farther from the coast, especially outside the Bay proper. That is the reason why Haarlem [1]), Alkmaar and Edam all show a change in the same direction: the continuation of the shingle wall from northwest via west to southwest and the presence of a lagoon west of the island. Edam gives the best demonstration of this condition. The lagoon to the west side of the island is about as large as the eastern one and it provides ideal conditions for study of lagoon life. This condition at Edam, a lagoon east and another west, is typical for all Thousand Islands, though the eastern lagoon is normally much the larger [2]). Edam, in its geomorphological

[1]) UMBGROVE (1928, p. 14), in his sketch of Haarlem (fig. 7), has omitted the low western shingle wall which emerges during very low tides.

[2]) The relatively small size of the eastern lagoon of Edam may be due to the protection from eastern winds, given to the island by the land of Tandjong Krawang.

as well as in its ecological peculiarities is intermediate between the true Thousand Islands and the islands of the Bay of Batavia proper.

Another part of the coral island needing study is the reef slope. The north south section through Hoorn showed us a steep slope at the south side of the island, whereas along the north side the upper part of a rich reef slopes gradually to about 5 metres, then remains of constant depth in seaward direction and finally slopes rather steeply to the lower edge of the reef. Krämer, in his description of the slopes of Pacific islands, mentions the same difference between lee and wind side: everywhere he finds a very steep slope at lee, a more gradual one at the windward side. The slope there consists, according to him, of an upper part, gradually sloping to a depth of 5 m, called by him „die Brecherböschung", and a deeper steeper slope, called by him ,,die Dachböschung". He does not describe the plateau between Brecher- and Dachböschung, and I suppose that he may have overlooked it in many cases, as it is not easily studied without a diving helmet. His Brecherböschung may therefore consist of upper slope or upper slope + plateau, his Dachböschung is the steep slope below. It is interesting to see the great conformity in geomorphology between such reefs as those of the Pacific and small reefs of the Bay of Batavia. The reefs of the Bay are like Pacific reefs on a very minute scale!

As already described by Krämer, the steepness of the southern slope is due to the quietness of the water, whereas the gradual slope at the windward side is due to wave action. Therefore, where the contrast between windward and lee side is smaller, the difference in declination between both slopes is smaller. At the islands in the Bay of Batavia, where the contrast between sea- or day- and land- or nightwinds is very great, the windward side of the reef slopes very gradually, whereas the bare leeside slope is very steep: Hoorn, Rotterdam, Kerkhof, Purmerend all show this phenomenon quite distinctly. At Edam too, the difference is very great, but we will see later that its southern slope differs much from that of the Bay islands, as it shows a more or less rich growth of corals. If we take Dapur as an instance of a typical Thousand Islands reef, we find that the south slope, which shows a luxuriant growth of corals, is much less steep than on the foregoing islands. The land and sea wind system is less strongly developed, a rather strong surf may at times beat the south side and this causes a less steep slope there. At the same time the influence of currents is greater, of sedimentation smaller and a luxuriant growth of corals, with common occurrence of more exacting species, bounds the leeside of the island. It is interesting to compare the islands Tidoeng and Pari too (compare plates V and VI in Umbgrove, 1929). One will be astonished to find here rather steep slopes along both sides of the islands, north as well as south. They belong to these islands as their oblong shape. Both phenomena, the form of the islands (Tidoeng is nearly 4 km long and in its widest part only 250 m wide) [1]) and the steep slopes at the north side,

[1]) Tidoeng consists of two islands: Tidoeng besar, about 3900 × 250 m, and Tidoeng ketjil, about 1600 × 150 m. Their longitudinal axes are lying in one line, but they are separated by a small channel.

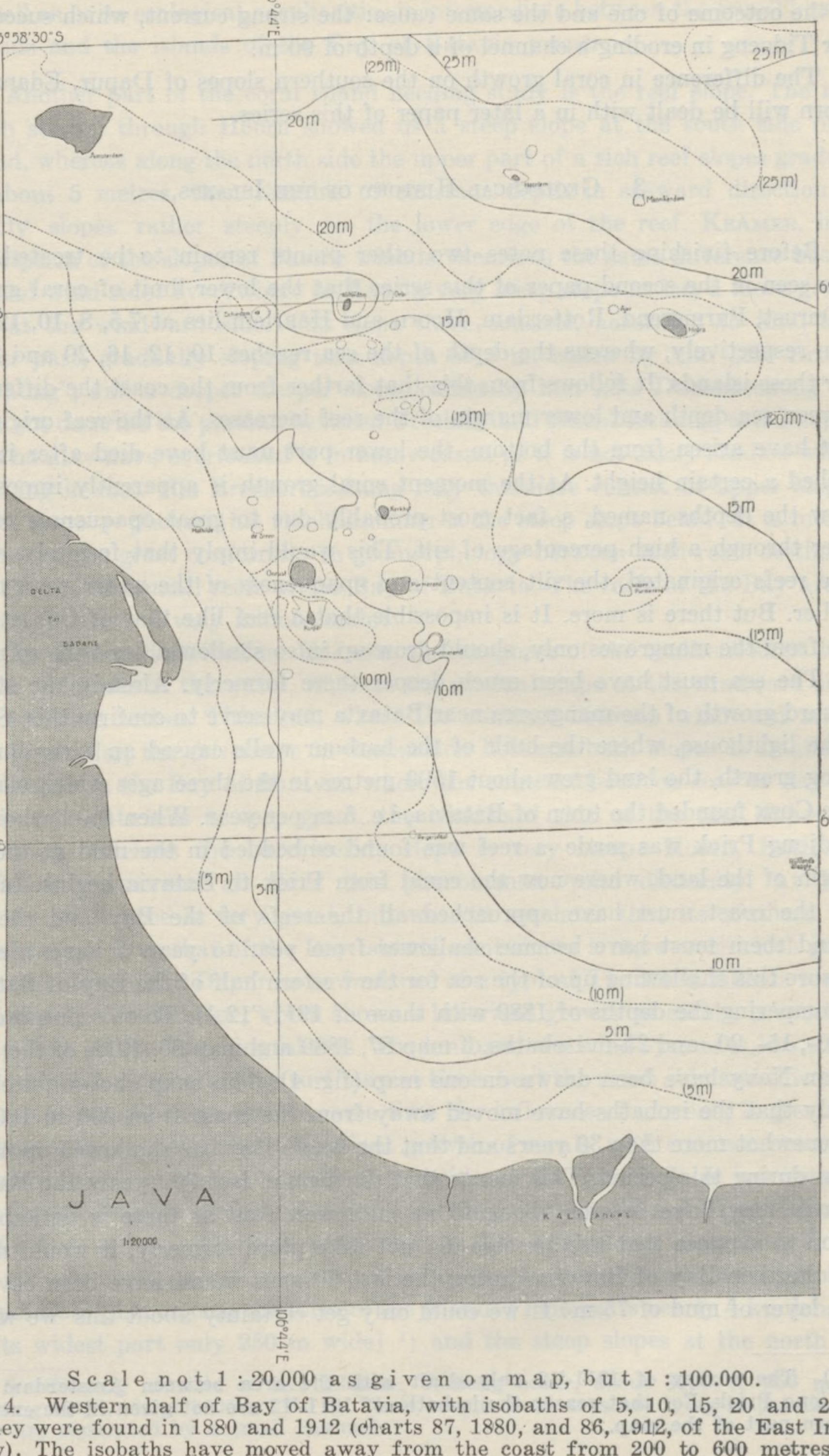
are the outcome of one and the same cause: the strong current, which succeeded near Tidoeng in eroding a channel of a depth of 90 m.

The difference in coral growth on the southern slopes of Dapur, Edam and Hoorn will be dealt with in a later paper of this series.

3. GEOLOGICAL HISTORY OF THE ISLANDS.

Before finishing these notes two other points remain to be treated. We have seen in the second paper of this series that the lower limit of coral growth at Onrust, Purmerend, Rotterdam, Hoorn and Haarlem lies at 7.5, 8, 10, 12 and 15 m respectively, whereas the depth of the sea reaches 10, 12, 16, 20 and 22 m near these islands. It follows from this that farther from the coast the difference between sea depth and lower margin of the reef increases. As the reef originally must have arisen from the bottom, the lower part must have died after it had reached a certain height. At the moment coral growth is apparently impossible below the depths named, a fact most probably due to great opaqueness of the water through a high percentage of silt. This would imply that formerly, when these reefs originated, the silt content and opaqueness of the water were much smaller. But there is more. It is impossible that a reef like that of Onrust, one mile from the mangroves only, should grow up in so shallow a sea with so much silt. The sea must have been much deeper there formerly. Already the strong seaward growth of the mangroves near Batavia may serve to confirm this. South of the lighthouse, where the built of the harbour walls caused an exceptionally strong growth, the land grew about 1500 metres in the three ages which elapsed since COEN founded the town of Batavia, i.e. 5 m per year. When the harbour of Tandjong Priok was made a reef was found embedded in the mud at the old margin of the land, where now the canal from Priok to Batavia begins. In this way the coast must have approached all the reefs of the Bay and the sea around them must have become shallower from year to year. I have tried to measure this shallowing up of the sea for the western half of the Bay of Batavia by comparing the depths of 1880 with those of 1911/'12 [1]). To this purpose the 5-, 10-, 15-, 20- and 25-m isobaths of map 87, 1880 and map 86, 1912, of the East Indian Navy have been drawn on one map (fig. 4). This map shows quite distinctly that the isobaths have moved away from the coast from 200 to 1600 m in somewhat more than 30 years and that the whole Bay has shallowed up about 1.5 m during this period. This means that during the last 300 years the Bay of Batavia may have become about 15 m shallower. And as there is perhaps no reason to suppose that this process did not take place formerly, it would mean that the then Bay of Batavia during the last 20 ages would have been covered by a layer of mud of 75 m! If we could only get certainty about this we would

[1]) The survey of 1911-'12 only dealt with the area between Amsterdam and Tandjong Priok. For that reason the isobaths of 1911-'12 are not given in the extreme western part of the map.



Scale not 1 : 20.000 as given on map, but 1 : 100.000.

Fig. 4. Western half of Bay of Batavia, with isobaths of 5, 10, 15, 20 and 25 m, as they were found in 1880 and 1912 (charts 87, 1880, and 86, 1912, of the East Indian Navy). The isobaths have moved away from the coast from 200 to 600 metres and the whole Bay has shallowed up about 1.5 m during the period in question.

know that the depth of the then Bay of Batavia was no less than 90--100 m unless we should assume a sinking of the land since that time [1]).

Borings at Kuiper and Onrust further confirm this, though it is not easy to interprete them rightly. — The boring at Onrust was made at the south side of the island. Taking into account the particulars about growth and movement of the islands, as dealt with above, it is possible that the boring never passed the reef itself, as is made evident by the data. The figures show that coralsand was found up to a depth of 17 m and that corals were found between 17 and 19 m [2]). This would show only that the sea immediately south of the reef had a depth of 19 m when the island, by growing south, had reached the place of the boring; the boring tells us nothing about the depth of the reef itself. — The boring at Kuiper was made at the north side of the island near the beginning of the long stair. It produced sand with coral fragments and molluscs up to a depth of 23 m; there below, up to 76 m depth, clay or sandy clay with coral fragments and molluscs was found [3]). UMBGROVE, taking the limit between sand and clay as the base of the reef, concluded that the reef had a thickness of 23 m. I doubt if we are allowed to do so. At Onrust where the boring may have missed the reef, we find corals up to 19 m only [4]), at Kuiper where the boring should have passed the reef we find corals to a depth of 42, possibly to a depth of 76 m. The possibility is perhaps not to be excluded that the foundations of these reefs were laid at a bottom, now found 42 or even 76 m below sea level. In the lastnamed case we would perhaps have to assume a sinking of the land since these reefs originated. — All in all, these particulars point to the possibility, that the reefs of Batavia Bay originated in a sea of much greater depth than we find at present and that the lower limit of coral growth retired more and more when the transparency of the water became smaller. This would support MOLENGRAAFF's conclusion that river courses in the southern Java Sea are no longer recognizable as they became embedded in large quantities of mud.

This point has finally brought us to the development of the Thousand Islands Archipelago as a whole. MOLENGRAAFF, finding the great depths near Pajoeng, assumed that the Thousand Islands had grown up at the margin of the old Sunda shelf during the sinking of former land. UMBGROVE, who came to the

[1]) The map is interesting for other reasons too. In the first place it shows the enormous influence of the reefs on the waterflow, and of the latter on the configuration of the bottom. We see how the isobaths avoid the islands and how the latter are bounded by channels of greater depth. How far this influence of the reefs may reach, is nicely shown by the 20 m isobath, where it approaches Hoorn: at a distance of more than one kilometre from the reef, it curves southward! As all the isobath deviations face with their dead ends to the west (WNW) the current flows chiefly in that direction. — The map is in the second place interesting because all isobaths show a strong bend to the north somewhat east of longitude 106° 44′. The only explanation I can give of these bends is that the water, flowing in a western direction in the Bay proper, in meeting the west coast of the Bay, is deviated to the north and so deepens out a bed in the soft mud, which slowly curves to the west north of the Bay.

[2]) There below corals were found again between 31 and 35 m.

[3]) Between 42.10 and 50.30 m corals are not mentioned in the report.

[4]) I neglect here the corals found between 31 and 35 m.

conclusion that the great depths must be due to erosion, assumed that the islands grew up on a NS ridge in the southern Java Sea. This ridge could, according to UMBGROVE, be the expression of an anticline. UMBGROVE came to this assumption, as he found that the sea west of the Thousand Islands shows a number of long banks, which are somewhat shallower than the surrounding sea. He considered them to be the remains of the original ridge and ascribed their increase in size in a northward direction to the smaller influence of erosion farther from Sunda Strait.

The hypothesis of UMBGROVE is — in my mind — rather unsatisfactory. The assumption of a northsouth anticline finds certainly little support in the geology of Java. The sea west of the Thousand Islands shows a bottom of sand (map VI in MOLENGRAAFF 1922) and we know from VAN WEEL's investigations and from fig. 4 that the water of the southern Java Sea is flowing chiefly west. This opens the possibility that the banks west of the Thousand Islands consist of material from the Thousand Islands themselves. The banks are larger more northward and do not occur in the southern part; this may show that the strong current in the south, which succeeded in eroding depths of 90 m and more made sedimentation of sand impossible, whereas the weaker current more northward did not prevent sedimentation, so that large banks could be formed there.

I personally feel inclined to seek the cause of the development of this fine reef Archipelago in the excellent conditions the Java Sea offers not far from Sunda Strait. I venture to suggest this biological explanation in the place of the geological ones, because it stroke me much during my visits that the richest development of the reefs is to be found in the southern half of the Archipelago whereas the reefs appeared to me to become distinctly poorer north- as well as south(east)ward. Though this impression needs confirmation by detailed surveys of a great number of reefs, it is already supported by the fact that the largest reefs are to be found in the southern part, where the reefs are so very rich. Moreover the ecological survey of Dapur, Edam, Hoorn and Onrust, which will be given in a later paper, has shown that a large silt quantity of the water may coincide with a luxuriant development of the reef, when currents are strong enough only to prevent strong sedimentation. It appears to me therefore that it is quite possible that the upgrowth of the Thousand Islands in this special area was and is made possible by the ideal combination of two factors: 1. a certain amount of silt and 2. a current of such a strength that the silt can be used by the corals without causing damage. I agree with UMBGROVE that we should have a boring to settle this question. It certainly would help us finally to solve a much discussed problem, and would yield results of great scientific interest.—

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VERWEY, J. (1931) — Coral Reef Studies. II. Depth of Coral Reefs in relation to their Oxygen Consumption and the Penetration of Light in the Water. Treubia, this volume.

Explanation of Plate 2.

Fig. 1 The w e s t e r n group of mangrove trees of text figure 3 in 1927, seen from the east. The trees are growing on the beach and there is a channel between trees and shingle wall.

Fig. 2. The same group of trees on 31 May 1931, seen from a place somewhat more to the south than in 1927. The shingle wall has filled up the channel and partly covered the trees.

Fig. 3. The e a s t e r n group of mangrove trees of text figure 3 on 31 May 1931, seen from the east. The high shingle wall has reached the trees and is covering them.

Fig. 4. The same group of trees seen from the west. The shingle wall has reached the sandy beach and shut off the lagoon water west of the spot.

UMBGROVE photo 1

MIDDELAER photo 2

MIDDELAER photo 3

MIDDELAER photo 4

On page 219 allusion is made to the possibility that what is called *Stolephorus zollingeri* in this paper is in reality a new species not mentioned by previous investigators, BLEEKER's *St. zollingeri* being the eastern species for which we found 24 + 18 = 42 vertebrae. This conception has afterwards appeared to us to be the right one. The question will be discussed more fully by Dr. HARDENBERG in his paper on the Indian *Stolephorus* species. He probably will propose there to call the new species *Stolephorus pseudoheterolobus*. The eggs 1 and 2, then, must be ascribed to this species. —

H. C. D.

FISH EGGS AND LARVAE FROM THE JAVA SEA [1]

by

DR. H. C. DELSMAN.

(Laboratorium voor het Onderzoek der Zee).

17. The genus Stolephorus (with 60 figures).

The oblong shape of the egg of *Engraulis encrasicholus*, first described by WENCKEBACH in 1887 [2], makes it one of the easiest recognizable among fish eggs. In 1901 NISHIKAWA [3]) showed a similar elongated egg for the Japanese *Engraulis japonicus*. The former egg has a length of 1.3—1.9 mm and a breadth of 0,7—1,2 mm, the latter a length of 1.2—1.6 mm and a breadth of 0.55—0.7 mm. Neither of the two contains an oil-globule.

In 1913 KUNTZ [4]) states that the egg of *Anchovia mitchilli* is likewise elongated, though much less than in both of the species first mentioned. In *Anchovia argyrophana* and *brownii*, however, he and RADCLIFFE [5]) find the elongation to be more pronounced again. The same holds for the egg of *Anchovia epsetus*, according to HILDEBRAND [6]). Besides, all the species mentioned have in common the segmented yolk so characteristic of the eggs of herring- and eel-like fishes. None of them contains an oil-globule.

From the above it appears probable that the elongated shape is characteristic for the genera *Engraulis* and *Anchovia* (or, better, *Engraulis* and *Stolephorus*, cf. nr. 12 of this series, Treubia Vol. XI p. 276).

My investigations, however, have not fully confirmed this conclusion. In nr. 12 of the present series I have shown that the eggs of all the Indian *Engraulis* species studied by me are round or nearly so. The elongated eggs found in the plankton of the Indian seas all prove to belong to the genus *Stolephorus*. In the latter genus only do we find eggs of an elongated shape in the ripe ovaries.

Quite a number of varieties of these elongated eggs occur in the Java Sea, especially along the coasts of Java, Sumatra and Borneo. The yolk is segmented, as in other clupeoid eggs. Some of them contain an oil-globule, others not.

[1]) cf. Treubia Vol. II p. 97, Vol. III p. 38, Vol. V p. 408, Vol. VI p. 297, Vol. VIII p. 199 and p. 389, Vol. IX p. 338, Vol. XI p. 275, Vol. XII p. 37 and Vol. XII p. 367.

[2]) K. F. WENCKEBACH, 1887, Verslag omtrent op de ansjovis betrekking hebbende onderzoekingen. Verslag Staat Nederl. Zeevisscherijen over 1886.

[3]) T. NISHIKAWA, 1901, On the Development of Engraulis japonicus. Journal of the Fisheries Bureau (Tokyo), Vol. X nr. 1.

[4]) A. KUNTZ, 1913, The Embryology and larval Development of Bairdiella chrysura and Anchovia mitchilli. Bulletin Bureau of Fisheries, Vol. XXXIII.

[5]) A. KUNTZ and L. RADCLLIFFE, 1917, Notes on the Embryology and larval Development of twelve Teleostean Fishes. ibid. Vol. XXXV.

[6]) S. F. HILDEBRAND and L. E. CABLE, 1930, Development and Life history of fourteen Teleostean Fishes at Beaufort, N.C. ibid. Vol. XLVI.

A few of them have an egg-membrane with a little knob at the place of the micropyle. Only one of them reaches to the size of the egg of the European anchovy.

The number of varieties which may be distinguished among these eggs is greater than the number of *Stolephorus* species enumerated e.g. by WEBER and DE BEAUFORT who in this respect follow BLEEKER in his "Atlas ichthyologique". The two authors distinguish the following five species:

Stolephorus zollingeri		length not above 100 mm, origin of anal behind dorsal.
„	*heterolobus*	
„	*indicus*	length more than 100 mm, origin of anal under dorsal.
„	*commersonii*	
„	*tri*	

For the average numbers of vertebrae in these species my assistant Dr. HARDENBERG has found:

	trunk		tail		total	
Stolephorus zollingeri	23.2	+	19.4	=	42.6	(3.8)
„ *heterolobus*	21.9	+	19.8	=	41.8	(2.1)
„ *indicus*	21.9	+	20.8	=	42.8	(1.1)
	(21.0	+	20.0	=	41.0)	(1.0)
„ *commersonii*	20.0	+	18.9	=	38.9	(1.1)
„ *tri*	19.0	+	19.0	=	38.0	(0)

The species have been arranged in such a way that we see the number of trunk vertebrae decrease gradually and approach more and more to that of the tail vertebrae. This is shown at once by a look at the figures in brackets indicating the difference between the number of trunk and of tail vertebrae. The anus thus moves forward in this series.

In the same series we see the total number of vertebrae decrease gradually from 42.6 to 38.0. *Stolephorus indicus* only forms an exception, having the highest number of vertebrae of all. *Stolephorus indicus* is also the species attaining the largest size. Dr. HARDENBERG, however, also found a smaller variety of this species characterized by a lower number of vertebrae, viz. 21,0 + 20.0 = 41.0 which fits in better in the above series.

Taking into account also what the examination of the ripe ovaries teaches us about the shape of the egg, we can conveniently divide these Indian *Stolephorus* species into three groups. In the first place *Stolephorus indicus* and *commersonii* evidently form a natural group, as follows from the fact that in both these species the ripe ovarial eggs show the little knob so characteristic of the pelagic eggs shown in fig. 1 nr.3 and 4. A second group is formed by the small and slender species *Stolephorus zollingeri* and *heterolobus,* characterized by a relatively high number of trunk vertebrae, i.e. a relatively backward situation of the anus, causing also the anal fin to begin behind and not under the dorsal fin.

The third group includes provisionally the species *Stolephorus tri* only which occurs in and near river mouths. It has the relatively lowest number of trunk vertebrae, the shortest trunk.

After I had found that the number of different kinds of elongated eggs surpasses that of the species of *Stolephorus* distinguished up till now, a renewed study of these species seemed desirable. At my request Dr. HARDENBERG has taken up this study. He has found, as suggested by my results, that the number of species is indeed higher than was known thus far.

As regards the group with the highest relative numbers of trunk vertebrae, Dr. HARDENBERG got a species surpassing in this respect the two mentioned above. It has the following numbers of vertebrae:

$$24 + 18 = 42 \quad (6)$$

and seems to occur only in the more oceanic waters of the eastern part of the archipelago, the south coast of Java etc. (It is also possible that it is this species which has been called *zollingeri* by BLEEKER who obtained it from Makasser (Celebes). The type specimen has been lost [1])).

The middle group, with the knobbed eggs and an intermediate number of trunk myotomes, also proved to contain more species than have been distinguished thus far. Besides *Stolephorus commersonii* and *indicus* at least one new species must be distinguished which we propose to call *Stolephorus insularis* because it seems to be a species characteristic e.g. of the islands between Bangka and Singapore though by no means restricted to this area. For the number of vertebrae Dr. HARDENBERG found as an average:

$$20.1 + 18.9 = 39.0 \quad (1.2).$$

In samples from other places somewhat different numbers were found, viz.

$$20.0 + 20.0 = 40.0 \quad (0)$$
$$21.0 + 20.0 = 41.0 \quad (1)$$
$$20.1 + 19.8 = 39.9 \quad (0.3).$$

which is probably to be explained from the existence of varieties or subspecies.

The eggs with a knob are characteristic of all these species.

Finally we have to deal with the group with the lowest number of trunk vertebrae, the species and varieties of which have thus far been united under the name *Stolephorus tri.* We will see that the eggs of this group are characterized by the presence of an oil-globule and occur in or near river mouths. Quite a number of varieties of these eggs could be distinguished and on closer investigation Dr. HARDENBERG found that indeed the species *Stolephorus tri* is by no means homogeneous but comprises several varieties or even species.

Thus I met regularly three varieties of these eggs in the aestuary-like mouth of the Rokan where an intensive fishery is carried on by the Chinese fishers of the important fisher-place Bagan Si Api Api. And indeed Dr. HARDENBERG succeeded in distinguishing three types of *Stolephorus*. One of these seems to be *Stolephorus tri* sensu stricto. The other two represent at least one separate species, comprising two sub-species. We propose to call this species *Stolephorus baganensis*. A slightly different type was obtained from the Musi mouth which seems to Dr. HARDENBERG to belong also to this species.

[1]) BLEEKER, Bijdrage tot de kennis der Clupeoiden. Verh. Batav. Genootschap XXIV, 1852, p. 39.

For *Stolephorus tri* the following average numbers of vertebrae were found:
19.0 + 19.0 = 38.0 (from Amphitrite Bay, south of the Rokan)
19.0 + 18.8 = 37.8 (from Cheribon).
For *Stolephorus baganensis* Dr. HARDENBERG found:
18.8 + 19.6 = 38.4 (from Bagan)
19.1 + 18.8 = 37.9 (from Bagan, the other variety: var. *megalops*)
19.2 + 20 = 39.2 (Musi-river, slender variety)
19.0 + 19.4 = 38.4 (from Batavia)
19.0 + 19.5 = 38.5 (from Cheribon).

It is evident that *Stolephorus tri* and *baganensis* do not differ much as regards the numbers of vertebrae. In *St. baganensis*, however, we see as a rule the number of trunk vertebrae sink below that of the tail vertebrae, as is the case in no other *Stolephorus* species (but characteristic of the genus *Engraulis*). The only exception is the var. *megalops*.

This, then, is a rough sketch of the results of Dr. HARDENBERG's investigations which I hope will be soon published more fully.

We now turn again to the eggs.

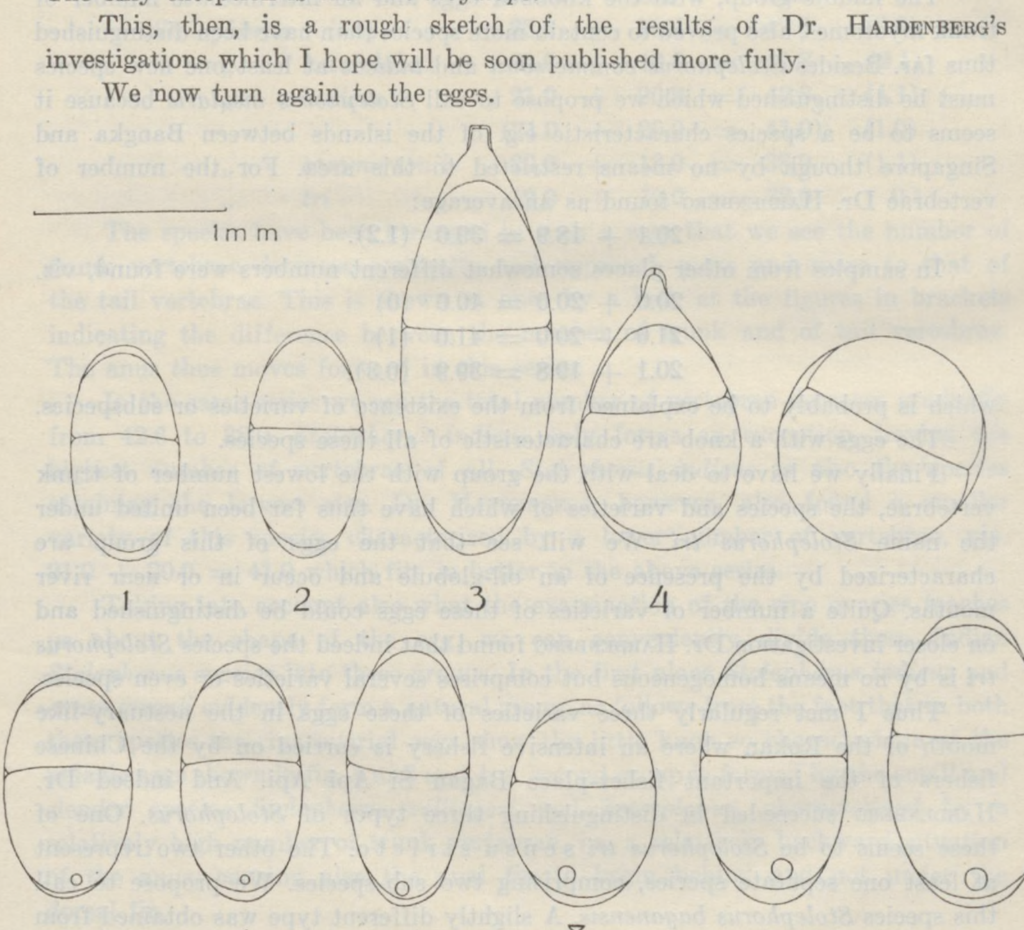
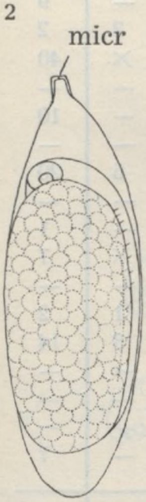


Fig. 1. Ten kinds of *Stolephorus* eggs from the Java Sea, × 26. The egg without a number belongs to *Engraulis mystax*. For further identification of the eggs cf. p. 240.

Let us begin with the *Stolephorus* eggs provided with a terminal knob at the animal end of the egg-membrane. The shape of this knob may be seen from figs. 1, 2 and 3. It is hollow, but its wall is thicker than the rest of the egg membrane. The terminal wall is pierced by a fine canal, the micropyle. These eggs contain no oil-globule and are found at a somewhat greater distance from the coast than the eggs with an oil-globule. From the examination of ripe ovaries it is evident that the eggs with a knob belong to the group *Stolephorus indicus-commersonii-insularis*.

2



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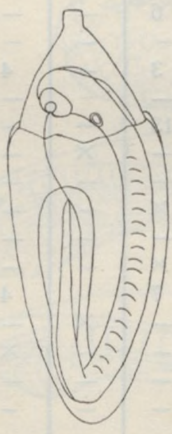

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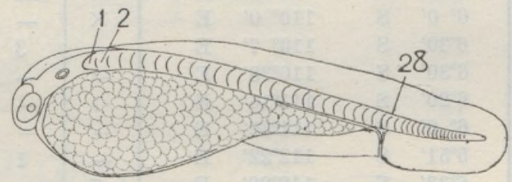

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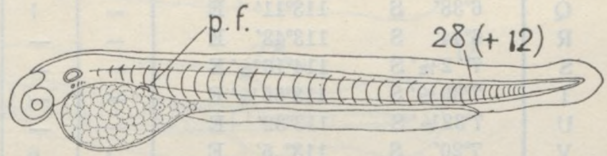

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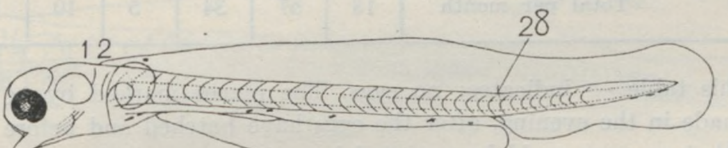


Fig. 2. The egg nr. 3 at 9 a.m., × 26. *micr.* = micropyle.
Fig. 3. Similar egg hatching, × 26.
Fig. 4. Newly hatched larva, × 26. 1, 2 the anteriormost myotomes.
Fig. 5. Larva of 18 hours, × 26. *p.f.* rudiment of the pectoral fin.
Fig. 6. Larva of the third morning after hatching, × 26. Yolk resorbed, eyes black.

However, I have thus far been able to distinguish two varieties only of these eggs. The most common one of these two is the following (nr. 3 of fig. 1):

Egg nr. 3. A knob at the animal pole. Length 2—2.25 mm, breadth 0.67—0.8 mm. In rest lying horizontally beneath the surface or, at a slight disturbance of the water, floating with the knob down (in general pelagic eggs float with the head of the embryo directed downward). This egg is common at some distance from the coast, it was found frequently e.g. in the catches made during the periodical cruises of 1919—1920 (cf. Treubia II p. 106). They were distributed over these 6 × 21 catches (vertical hauls) as follows:

Station			July 1919	September 1919	November 1919	January 1920	March 1920	May 1920	Total per Station
A	5°50′ S	106°10′ E	—	—	—	2	—	—	2
B	5°48½′ S	106°36′ E	—	×	—	×	—	—	—
C	5°44′ S	107°15′ E	—	—	2	1	—	—	3
D	5°42′ S	107°50′ E	×	8	3	2	1	2	16
E	6° 0′ S	107°58½′ E	4	4	—	—	1	—	9
F	6° 0′ S	109° 0′ E	—	×	—	—	—	2	2
G	6°35′ S	109°16′ E	—	34	6	—	—	×	40
H	6° 0′ S	110° 0′ E	×	—	—	—	—	—	—
I	6°30′ S	110° 7′ E	—	3	3	—	4	—	10
K	6°30′ S	110°38′ E	—	—	—	-	—	—	—
L	6°20′ S	111°16′ E	1	—	13	—	—	6	20
M	6° 0′ S	111°30′ E	—	—	—	×	—	—	—
N	5°51′ S	112°22′ E	—	1	—	—	—	—	1
O	6°33′ S	112°20′ E	7	—	×	—	—	×	7
P	6°38′ S	112°39′ E	—	—	—	—	—	—	—
Q	6°38′ S	113°11′ E	—	1	×	—	—	1	2
R	6°44′ S	113°43′ E	—	—	7		4	3	14
S	7° 2½′ S	114°16½′ E	—	—	—	×	—	—	—
T	7°39½′ S	113°55½′ E	—	—	—	—	×	—	—
U	7°32½′ S	113°32′ E	—	—	—	—	—	—	—
V	7°20′ S	113° 5′ E	1	6	—	—	-	—	7
	Total per month		13	57	34	5	10	14	133

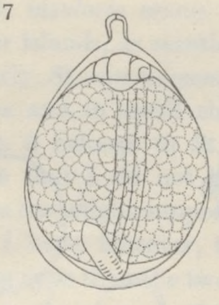
In this table — indicates: no eggs. The places marked by × relate to catches made in the evening, after the eggs have hatched and before spawning time, so that no eggs could be expected here.

We see that spawning goes on the whole year round, as is probably the case with most tropical fishes. For the rest the numbers are too small to warrant any further conclusions regarding spawning places, seasonal periodicity etc. I only should like to draw attention to the fact that on the four stations most distant from the coast, viz. F, H, M, N, no eggs or hardly any were caught. Also in Madura Strait (stations S, T, U, V) these eggs appear to be rare.

The second egg with a knob at the animal side (nr. 4) is much shorter, pear-shaped. Length about 0.8—0.9 mm. It is much rarer than the foregoing egg and thus far has never been found in considerable numbers but always a few specimens only. Thus I met this egg between the Thousand Islands and the Java coast (27.VI.1921 and 9.I.1922), north of Bantam (21.XI.1925) and near Amphitrite Bay (Sumatra, 17.I.1925 and 24.X.1926).

Spawning in all *Stolephorus* species, as in so many fishes, occurs at night, before midnight

7



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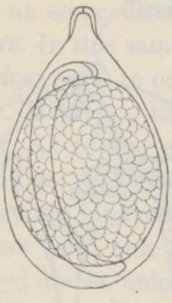

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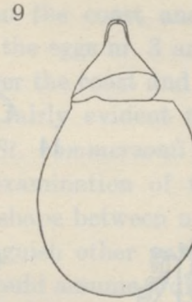

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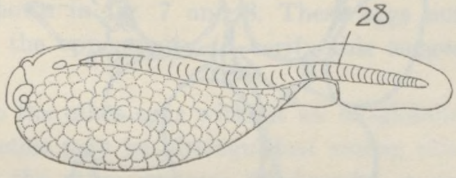

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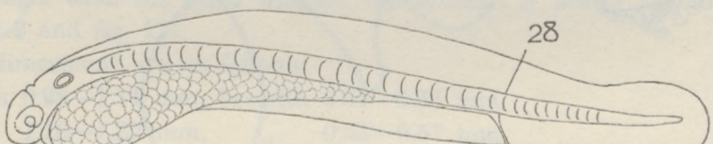

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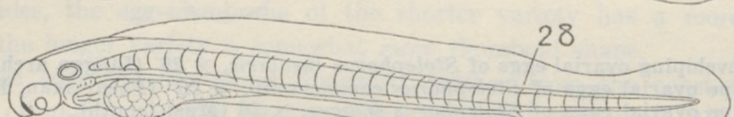

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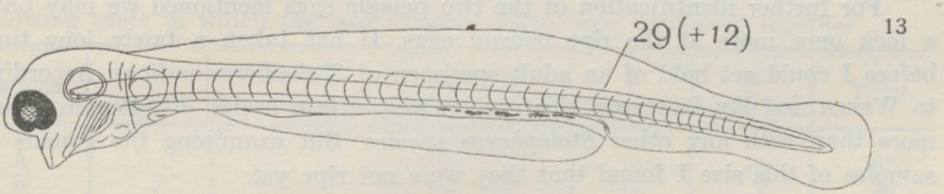

Fig. 7. The egg nr. 4, × 26. Amphitrite Bay, 17.I.'25.
Fig. 8. Similar egg from near the island of Dapur, × 26. 27.VII.'21.
Fig. 9. Similar egg after hatching, × 26.
Fig. 10. Newly hatched larva, × 26 (from the egg of fig. 8).
Fig. 11. Larva of 12 hours, × 26 (from the egg of fig. 8).
Fig. 12. Larva of 24 hours, × 26 (from the egg of fig. 8).
Fig. 13. Larva with yolk resorbed and black eyes (from the egg of fig. 7).

At 6 a.m. the two varieties of eggs mentioned above show a germinal disc surrounding the animal half of the egg. In the course of the morning the yolk blastopore closes and the larvae hatch at 6—7 p.m., after less than 24 hours. For the numbers of myotomes in the larvae I found in the longer egg

$$28 + 12 = 40$$

and in the shorter egg 27 — 29 + 12 = 39 — 41.

In the adult of this group the number of trunk vertebrae varies between 20 and 22. We see, then, that a forward movement of the anus during development over a distance of about 6—7 myotomes must be assumed.

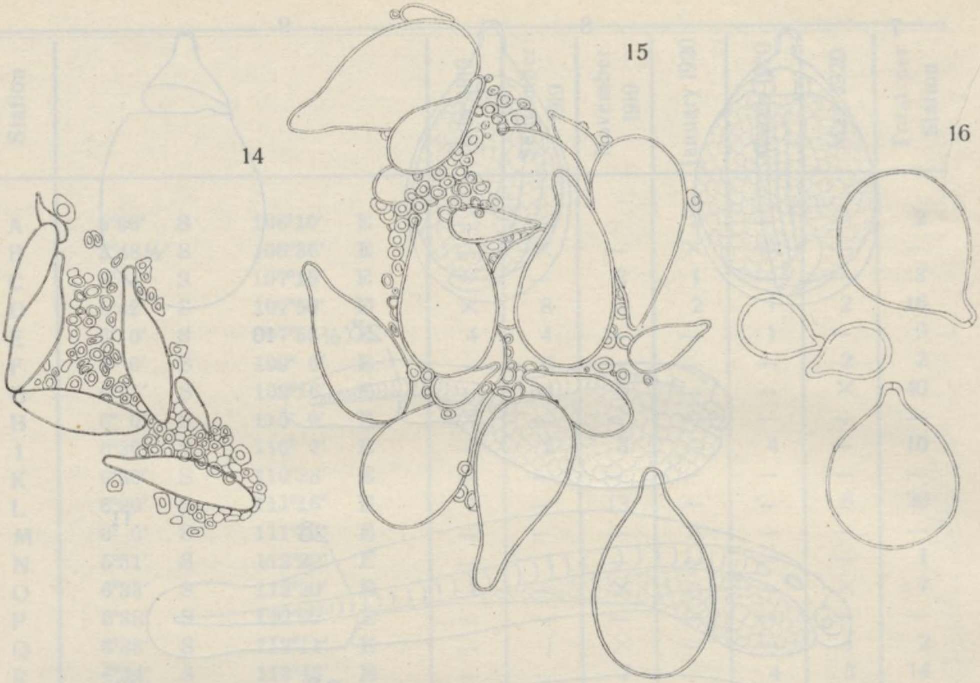

Fig. 14. Developing ovarial eggs of *Stolephorus insularis*, × 26 (Lingga archipelago).
Fig. 15. Ripe ovarial eggs of *Stolephorus commersonii*, × 26 (Pasar ikan, Batavia).
Fig. 16. Ripe ovarial eggs of *Stolephorus indicus*, × 26 (Musi mouth).

For further identification of the two pelagic eggs mentioned we may have a look once more at the ripe ovarial eggs. It has taken a fairly long time before I could get hold of an adult specimen of *Stolephorus indicus*. According to WEBER and DE BEAUFORT this species may attain a size of 145 mm, being more than with any other *Stolephorus* species. But examining the gonads of samples of this size I found that they were not ripe yet.

By chance I got a sample of 173 mm which was caught from the landing-stage at the fisher-village of Soengsang, at the mouth of the Musi-river (Sumatra). It proved to be a female and fairly mature. The ovarial eggs are shown in fig. 16. A look at them renders it evident that the egg nr. 4 must be ascribed to *Stolephorus indicus*.

Stolephorus commersonii is not rarely seen at the fish-market of Batavia, though never in considerable quantity. The adult specimens are known as t e r i g l a g a h. This is also one of the bigger species of *Stolephorus*, though smaller than *St. indicus*, attaining a length of about 120 mm. The ovarial eggs are shown in fig. 15. They are slightly more elongated than those of *Stolephorus indicus*.

Considerably more elongated are the ovarial eggs of *Stolephorus insularis* n.sp. (cf. above). They are shown in fig. 14. It seems hardly doubtful that the egg nr. 3 must be ascribed to the last named species and this assumption is supported by the following reflexion.

St. insularis seems to occur at some distance from the coast and round smaller islands, as mentioned above. In this same region the eggs nr. 3 are found regularly. *St. commersonii* and *indicus* seem to occur nearer the coast and in river mouths and in small shoals only. It seems, therefore, fairly evident that the egg nr. 3 belongs to *St. insularis*. As to the eggs of *St. commersonii* I must confess that I do not know them as yet. From the examination of the ripe ovaries one might suppose that they are intermediate in shape between nr. 3 and nr. 4. I have, however, thus far not been able to distinguish other varieties of this egg type than the two mentioned above, unless one would assume a difference between the eggs shown in fig. 7 and 8. These eggs not being very common I have not yet had the opportunity to verify this suggestion by the study of a larger number.

We now turn to the other eggs without an oil-globule. It has often seemed to me that two varieties may be distinguished among this group, the one being slightly longer than the other whereas the breadth is nearly the same (fig. 1 nrs. 1 and 2 and fig. 17).

The dimensions are as follows:

a. Length 0.98—1.14 mm, breadth 0.51—0.55 mm.
b. „ 1.10—1.22 mm, „ 0.53—0.57 mm.

Besides, the egg-membrane of the shorter variety has a more ellipsoid, that of the longer variety a somewhat more rhomboid shape.

These eggs too are found somewhat further from the coast than those with an oil-globule. In the catches of the periodical cruises of 1919—1920 e.g. a considerable number of these eggs is often present. This is shown by the following table in which the two varieties have been combined together.

Stations	1 (July'19)	2 (Sept'19)	3 (Nov'19)	4 (Jan'20)	5 (March'20)	6 (May'20)	Total
A	—	—	—	91	—	—	91
B	3	—	—	—	12	5	20
C	1	—	3	—	—	34	38
D	×	1	—	—	1	15	17
E	14	2	—	—	—	145	161
F	38	×	2	—	—	2	42
G	2	8	1	—	—	×	11
H	×	—	61	—	—	—	61
I	16	1	1	—	15	20	53
K	1	51	1	6	1	3	63
L	17	8	43	—	—	—	68
M	—	—	3	×	—	9	12
N	—	—	—	—	—	—	—
O	3	—	×	—	—	×	3
P	—	—	—	—	—	5	5
Q	—	—	×	—	—	5	5
R	—	—	14	1	1	—	16
S	—	—	—	—	1	1	2
T	—	—	28	×	—	—	28
U	—	—	—	—	×	—	—
V	—	6	—	—	15	1	22
	95	77	157	98	46	245	718

This table shows again that spawning evidently goes on the whole year round.

Some of the catches contain large numbers of these eggs. In order to find out whether the two varieties may always be separated from each other with certainty I have made a few length curves of the richest catches, as shown in fig. 17.

17

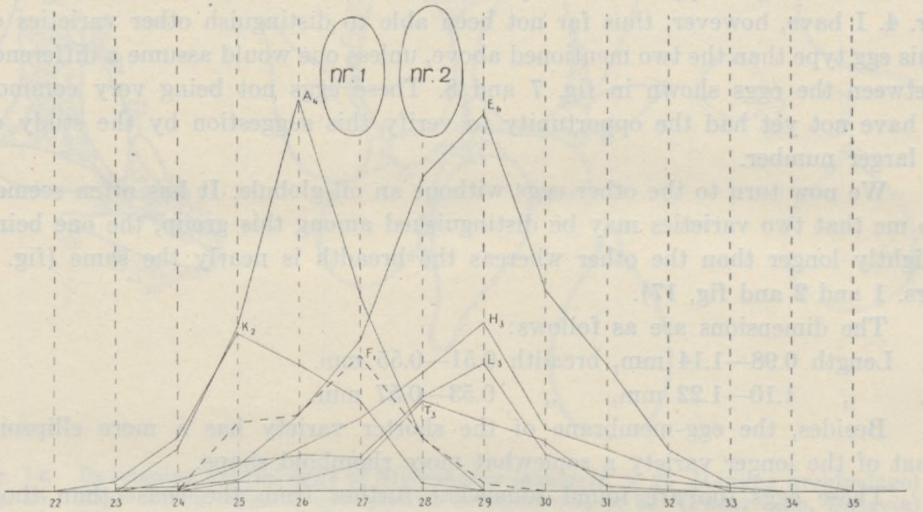

Fig. 17. **Frequency curves of the lengths, in degrees of my ocular micrometer (1 degree = 40,8 μ), of the eggs nr. 1 and 2 occurring in the richest catches during the periodical cruises of 1919 - 1920 (cf. Treubia Vol. II, p. 106).**

The lengths are expressed in stripes of my ocular micrometer. The two varieties may be clearly separated in the catches A4 and E6, being the two largest catches. Also in some of the smaller catches they may be distinguished: K 2, H 3 and L 3. The catches F 1 and F 3, however, leave room for doubt, whether we are dealing here with the longer or the shorter variety, or with a mixture of the two, in which case, however, a curve with two summits might have been expected.

That the two varieties exist seems to be supported by the numbers of the prae-anal myotomes of the larvae hatching from them.

Those from the shorter eggs were found to have 27—28, mostly 28, prae-anal myotomes, those from the longer eggs 28—30 (mostly 29). The larvae from these two eggs have a very characteristic feature in common which distinguishes them from the larvae from all the other elongated eggs. The terminal part of the gut does not extend to the border of the unpaired fin fold as is the case with nearly all other fish larvae. The vent is not situated on the border of this fold but either on the left or on the right side, close beneath the inferior border of the myotomes (cf. figs. 19—21 and 23—25).

I have the impression that the longer variety may be called the more oceanic of the two. I found it often near and in Sunda Strait (29.VII.'22,

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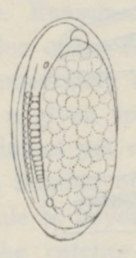

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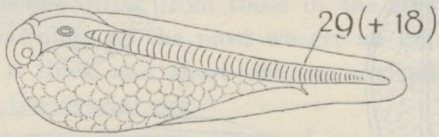

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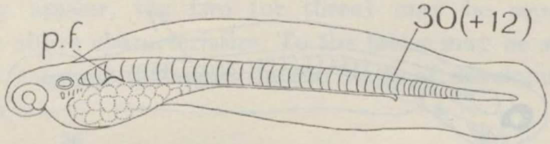

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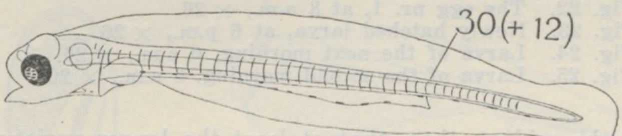

Fig. 18. The egg nr. 2, at 9 a.m. (7.IV.'24), × 26.
Fig. 19. Newly hatched larva, × 26.
Fig. 20. Larva of the next morning, × 26.
Fig. 21. Larva of the second day, 7 p.m., × 26.

21.VII.'24, 18—19.X.'26) and in Bali Strait (12.V.'24), also along the south coast of Java, e.g. near Trouwers Island (5.V.'26) and in the Wijnkoops Bay (9.V.'26) where I caught it over a depth of 2—3000 metres. Characteristic is this variety further for Malacca Straits, the Riouw- and Lingga-archipelago and the other islands between Bangka and Singapore where I find it quite regularly. Many were caught near the island of Bawean (north of Surabaya) in May 1924, together with the eggs of the l a j a n g (*Decapterus kurra*). In September 1928 and April 1929 I also found several of these eggs in the Bay of Batavia.

In the waters round the islands between Bangka and Singapore the most typical *Stolephorus* species are *St. insularis* and *St. zollingeri*.

The egg of the former has a terminal knob on the egg membrane. It is found regularly in the catches made in this region, together with the egg nr. 2. Thus the conclusion seems obvious that at least the latter and perhaps also the shorter variety, nr. 1, belongs to *St. zollingeri*. This tallies very well with the fact that *St. zollingeri* is a species with a high number of trunk vertebrae and that the larva from the egg has the highest numbers of trunk myotomes found among *Stolephorus* larvae. We find for the

number of vertebrae in the adult: 23.2 + 19.4 = 42.6
„ „ myotomes in the larva: 29 + 13 = 42.

Here, also, a forward movement of the anus over a distance of about 6 myotomes must be assumed.

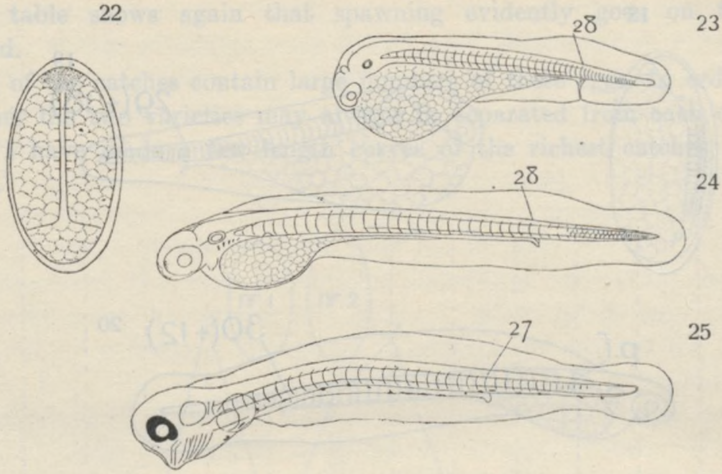

Fig. 22. The egg nr. 1, at 8 a.m., × 26.
Fig. 23. Newly hatched larva, at 6 p.m., × 26.
Fig. 24. Larva of the next morning, 6 a.m., × 26.
Fig. 25. Larva of the second morning, 6 a.m., × 26.

It seems fairly evident, then, that at least the longer variety of this egg belongs to *Stolephorus zollingeri.* The egg has a wide distribution and is a very common one outside the troubled coast waters.

What about the shorter variety? In looking for the origin of the latter I was at first inclined to ascribe it to *Stolephorus heterolobus,* the other small species with a relatively high number of trunk vertebrae. But continued observations have led me to an other conclusion, viz. that *St. heterolobus* has an egg with a small oil-globule to be described next. For the moment, therefore, I can suppose only that there are two varieties of *St. zollingeri,* perhaps as difficult to be distinguished from each other as are the eggs themselves.

Regarding the new *Stolephorus*-species with 24 + 18 vertebrae, as mentioned above, I have not yet succeeded in finding the eggs. The species has not yet been found in our special exploration area, the Java Sea and southern China Sea. The ripe ovarial eggs have the usual elongated shape, without a knob or any other characteristic feature.

We finally have to deal with the eggs with an oil-globule. They are so characteristic of the coast region and the river mouths that I did not find any of them in the catches from the periodical cruises 1919—1920 which have nearly all been made at a somewhat greater distance from the coast. Along the north coast of Java, however, and in the bay-like rivermouths of Sumatra and Borneo, quite a number of varieties may be observed, often differing only slightly from each other. This makes it often difficult to decide whether we are dealing with the eggs of definite races, or merely with variations due to external circumstances and passing gradually into each other. The only characteristics to judge from are the dimensions of the egg, the diameter, and sometimes the colour, of the oil-globule, and the number of trunk myotomes

in the larva hatching from the egg. All these values, however, are subject to fluctuations. Examination of the ripe ovarial eggs gives us indications of relative value only. The dimensions differ from those of the free eggs which swell up immediately before spawning. At the most we get an impression that the egg of a given species in a thick and short one, or a slender one. The oil-globule is not yet visible in the ovarial egg.

That a number of constant types may be discerned among the eggs with an oil-globule is beyond doubt. Often two or three of these types are found mixed in the catches in a certain locality and, however insignificant the differences may appear, the two (or three) may be separated with great accuracy by the above characteristics. To the latter may be added the fact that there is often a constant difference in the stage of development and the time of hatching also.

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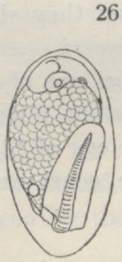

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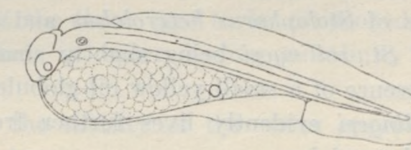

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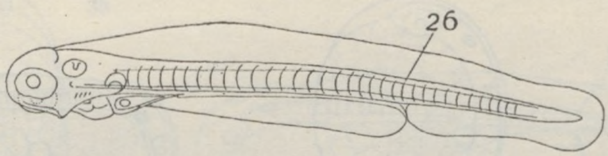

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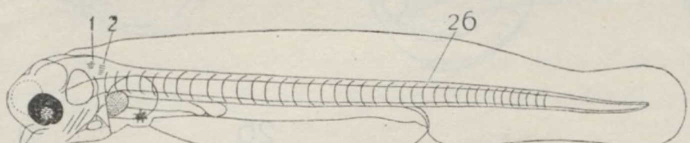

Fig. 26. The egg nr. 6, at 6 p.m., shortly before hatching, × 26.
Fig. 27. Newly hatched larva, × 26.
Fig. 28. Larva of 24 hours, × 26.
Fig. 29. Larva of the second day after hatching, × 26.

With one exception all of these eggs seem to belong to what has thus far been called *Stolephorus tri.* This exception is the egg nr. 6 which after all probability must be ascribed to *Stolephorus heterolobus.* The description of this egg is as follows:

Egg nr. 6. Length 1.10—1.26 mm, breadth 0.57—0.65 mm, characterized by a small yellow oil-globule with a diameter of 0.05 mm, this being the smallest oil-globule found among these eggs and at the same time easily recognizable by its bright yellow colour. The larva hatching from these eggs has 26—27 prae-anal myotomes.

Truly from this fairly low number of trunk myotomes in the larva one would not have supposed that this egg belongs to *Stolephorus heterolobus,* with its 21.9 + 19.8 = 41.8 vertebrae. At any rate the forward movement of the anus would cover a distance here of 4—5 myotomes only, against ± 6 in the species dealt with first.

The egg nr. 6, however, is by far the commonest *Stolephorus* egg along the coast of Java and in the Bay of Batavia. In these same places *St. heterolobus* is by far the commonest *Stolephorus* species. It was often found abundantly in places where the fishers did not catch anything but *Stol. heterolobus*. Along the east coast of Sumatra and between the islands off this coast the species and the eggs are absent but near Singapore both reappear.

Continued observations of this kind have convinced me that nr. 6 cannot be else than the egg of this species. The examination of the ripe ovarial eggs of *St. heterolobus* does not disprove this conclusion, at least they show no knob and are of a similar elongated shape as those of *St. zollingeri.*

So the eggs of *Stolephorus heterolobus* and *zollingeri* are of nearly equal size — that of *St. zollingeri* being slightly smaller — but differ from each other by the presence of a small yellow oil-globule in the egg of *St. heterolobus*. *Stolephorus zollingeri* evidently lives further from the coast and in clearer water than *St. heterolobus.*

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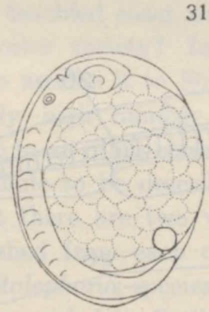

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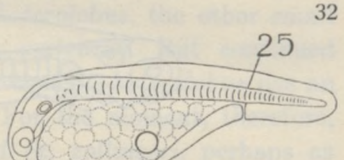

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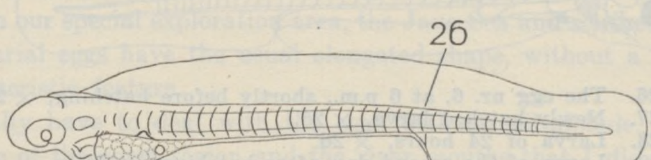

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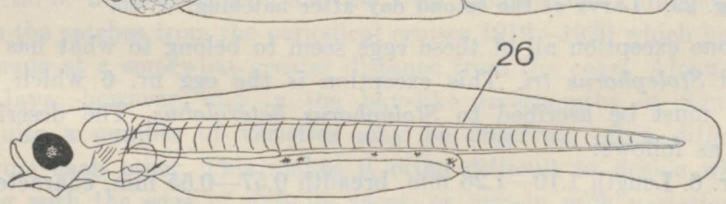

Fig. 30. The egg nr. 8 at 3.30 p.m., × 26.
Fig. 31. Big variety of the egg nr. 8, from the Kumai mouth, × 26.
Fig. 32. Newly hatched larva, at 5 p.m., × 26.
Fig. 33. Larva of the next morning, 8 a.m., × 26.
Fig. 34. Larva of the second morning, 7 a.m., × 26.

This holds equally for the occurrence of the eggs.

The remaining eggs with an oil-globule probably all belong to varieties of *Stolephorus* thus far designated as *Stolephorus tri*, evidently the littoral species "par excellence". This species seems to be rich in varieties, some of which might be given the rank of separate species. All these eggs have a bigger oil-globule than *Stol. heterolobus*.

Let us begin by considering three of them, which I have found regularly in the more or less brackish water of the estuary-like mouths of the Rokan and the Indragiri (east coast of Sumatra). These estuaries have a very characteristic fish fauna which, especially for the Rokan mouth, is very completely known now, thanks to the investigations of Dr. HARDENBERG.

The three varieties of *Stolephorus* eggs found in this region are:

Egg nr. 8. This is a particularly short and thick variety. Length 1.00—1.17 mm, breadth 0.81—0.72 mm, oil-globule slightly brownish, diameter 0.10 mm, pre-anal myotomes of the larva (25—)26. Sometimes eggs of this type are found with a clear yellow oil-globule. Of the three eggs to be mentioned here this is the one occurring furthest inward, in water having a salinity of from 29 to about 28$^0/_{00}$.

Further outward, where the salinity of the water approaches 30$^0/_{00}$ this egg is replaced by the other two.

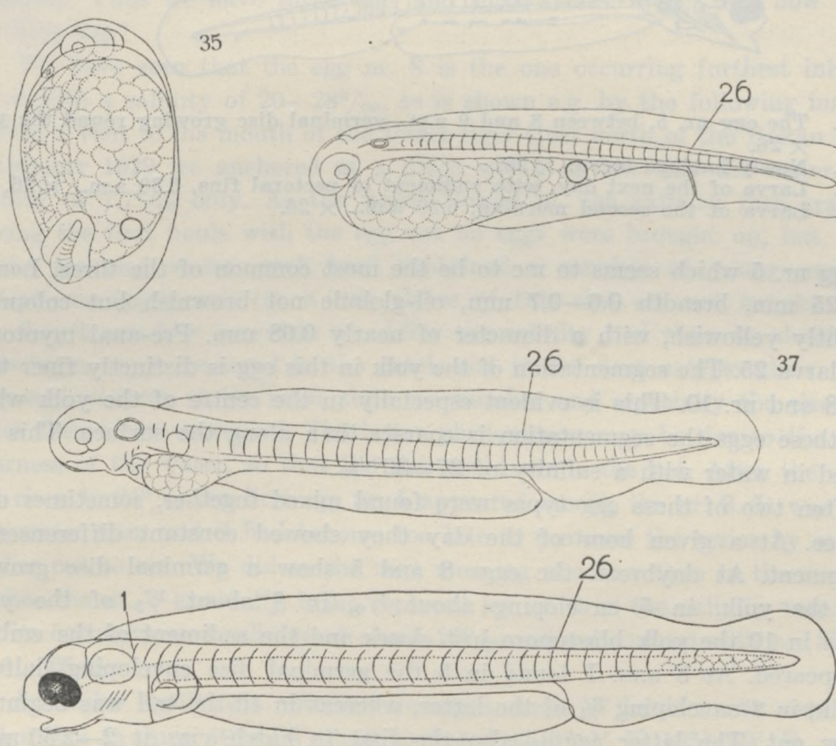

Fig. 35. The egg nr. 10, at 7 a.m. (10.I.'29, near Bengkalis), × 26.
Fig. 36. Larva a few hours after hatching, at 7 p.m., × 26.
Fig. 37. Larva of 12 hours, × 26.
Fig. 38. Larva of the second morning, × 26.

Egg nr. 10. Length 1.47—1.71 mm, breadth 0.75—0.82 mm, the oil-globule is slightly brownish, with a diameter of 0.12 mm. Pre-anal myotomes of the larva 26. This is the biggest of all the *Stolephorus* eggs, yet it does not quite equal in size the egg of the European anchovy (cf. above). It is often found together with the third variety.

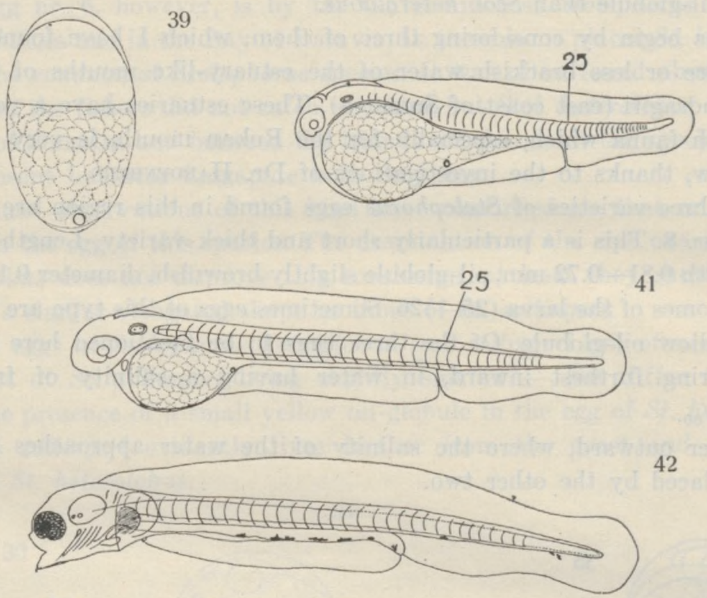

Fig. 39. The egg nr. 5, between 8 and 9 a.m., germinal disc growing round the yolk, × 26.
Fig. 40. Newly hatched larva, × 26.
Fig. 41. Larva of the next day, with rudiment of pectoral fins, 6.30 a.m., × 26.
Fig. 42. Larva of the second morning, 6.30 a.m., × 26.

Egg nr. 5 which seems to me to be the most common of the three. Length 1.1—1.25 mm, breadth 0.6—0.7 mm, oil-globule not brownish but colourless or slightly yellowish, with a diameter of nearly 0.08 mm. Pre-anal myotomes of the larva 25. The segmentation of the yolk in this egg is distinctly finer than in nr. 8 and nr. 10. This is evident especially in the centre of the yolk where in all these eggs the segmentation is coarser than along the surface. This egg is found in water with a salinity of $27—30^0/_{00}$.

Often two of these egg types were found mixed together, sometimes even all three. At a given hour of the day they showed constant differences in development. At daybreak the eggs 8 and 5 show a germinal disc growing round the yolk, in 5 enveloping about $^1/_6$, in 8 about $^1/_3$ of the yolk, whereas in 10 the yolk blastopore just closes and the rudiment of the embryo has appeared. At 8 a.m. I found in 5 the germinal disc enveloping halfway the yolk, in 8 enveloping ¾ of the latter, whereas in 10 the tail was beginning to grow out. The latter egg is also the first to hatch viz. at 2—2.30 p.m., whereas 8 follows at 5 and 5 at 7 p.m.

I think these differences must be explained by assuming that spawning takes place at different hours of the night.

During our visits with the investigation steamer to the estuaries of the Rokan and the Indragiri (Amphitrite Bay) the three varieties of eggs described above were quite regularly found in the surface catches. Now, as mentioned above, the fish fauna of the Rokan mouth — the operation field of the important, mostly Chinese, fishing port Bagan Si Api Api — is completely known. At my request Dr. HARDENBERG, during a stay of a month in January 1929 and during a shorter visit in October of that year, paid special attention to the *Stolephorus* species.

Besides *Stolephorus tri* he soon distinguished a separate species, the *St. baganensis* mentioned before, occurring on the whole more inland, in more brackish water than *St. tri.* This may be easily confirmed by comparing the catches of "jeremals" placed more inland with those situated more seaward in the river mouth.

St. baganensis differs from *St. tri* at first sight by its shape and pigmentation.

At my request looking further for a third variety, Dr. HARDENBERG found what seems to us may be most conveniently considered as a subspecies of *St. baganensis,* with bigger eyes and therefore designated as *St. baganensis,* var. *megalops.* Thus we have three eggs and three fishes. Which egg now belongs to which fish?

We have seen that the egg nr. 8 is the one occurring furthest inland, in water with a salinity of 20—28$^0/_{00}$, as is shown e.g. by the following instances. During a visit to the mouth of the Panei-river (just north of the Rokan mouth) in October 1929 we anchored at a place where at low tide the water had a salinity of 7.7$^0/_{00}$ only. As the water flowed in, the salinity rose gradually. During the first hauls with the egg net no eggs were brought up, but, thanks to the troubled water, each haul contained a number of young and older *Stolephorus baganensis* (as a rule fishes of this size are not caught by the net, they know how to evade it). After the salinity had risen to about 17$^0/_{00}$ a few eggs nr. 8 appeared in the catch and in the next catches their number increased whereas at the same time the number and especially the size of the fishes themselves decreased. The latter phenomenon may be due to the greater clearness of the water, so that the fish could evade the net. After the salinity had risen to 24$^0/_{00}$ the first egg nr. 5 appeared among the nr. 8. It was nearly high water then and it had become too late to continue the series by steaming further out to sea. We did so the next morning and saw then in the successive catches the nr. 8 gradually being replaced by nr. 5 as the salinity rose. Nr. 8 had its optimum at a salinity of about 27$^0/_{00}$ (already mixed with nr. 5), nr. 5 about 30$^0/_{00}$.

A similar result was obtained during a series of hauls made near Bagan Si Api Api in June 1923. We had anchored at 0° 1′ N 105° 49′ E.

At high water and during the beginning of the ebb flow we caught only

the big nr. 10, soon after mixed with nr. 5 (salinity 29‰). The first nr. 8 appeared at a salinity of 28 ‰. In the last haul of the series at nearly low tide (salinity 27‰, water troubled) nr. 8 dominated, still mixed with a few nr. 5 and an occasional nr. 10.

Also during other observations, e.g. in the mouth of the Koemai (Borneo), the impression was confirmed that nr. 8 is the egg occurring furthest inland and that nr. 5 and nr. 10 are found somewhat more seaward, often mixed, but as a rule nr. 10 reaching still somewhat further outward than nr. 5. Thus during a series of hauls in the Rokan mouth in October 2nd, 1929, I saw nr. 5 gradually being replaced, when steaming out to sea, by nr. 10. Not rarely, however, one may find not only two but even all three species mixed together in one catch, though not in equal quantities, the one having its optimum where the others reach the border of their distribution area.

From the fact that the eggs nr. 8 and nr. 10 are evidently more closely related mutually than to nr. 5 we may suggest that these two belong to the two races of *St. baganensis* and that nr. 5 belongs to *Stolephorus tri.*

From the fact that nr. 8 is the egg occurring furthest inward we may conclude that it belongs to *Stol. baganensis* proper and, consequently, that the egg nr. 10 belongs to the big-eyed race of the latter. Examination of the ripe ovaries shows that the eggs in *St. baganensis* are short and thick indeed, the length being as a rule 1½ × the breadth, or even less, whereas the ovarial eggs of *St. tri* are slender, the length being 2 × the breadth or more. Thus I think our identification of the three eggs occurring in the river mouths of Sumatra's east coast (and also of Borneo) is fairly reliable.

We come to the conclusion that

the egg nr. 8 belongs to *Stolephorus baganensis* proper,
„ „ nr. 10 „ „ „ „ var. *megalops,*
„ „ nr. 5 „ „ „ *tri.*

A comparison of the numbers of trunk myotomes of the larvae (25—26) with the numbers of trunk vertebrae in the adult fishes (± 19) shows that a forward movement of the anus over a distance of 6—7 myotomes finds place during development.

Three other eggs with an oil-globule are characteristic of the north coast of Java between Batavia and Cheribon. One of these is the egg of *Stolephorus heterolobus,* mentioned above. The other two are:

Egg nr. 9. Length 1.26—1.43 mm, breadth 0.70—0.77 mm, with a slightly brownish (not yellow) oil-globule having a diameter of 0.11 mm. Prae-anal myotomes of the larva 26.

Egg nr. 7 Length 1.30—1.47 mm, breadth 0.53—0.57 mm, with a colourless oil-globule of 0.08 mm. Pre-anal myotomes of the larva 26—27. The three eggs nrs. 6, 9 and 7 were often found mixed together in catches along the coast between Batavia and Cheribon. In that case nr. 9 proved always in a slightly further advanced stage of development than the other two. Thus, e.g. in a catch of April 26th, 1929, near Cheribon, at 6.30 a.m., the yolk in the eggs

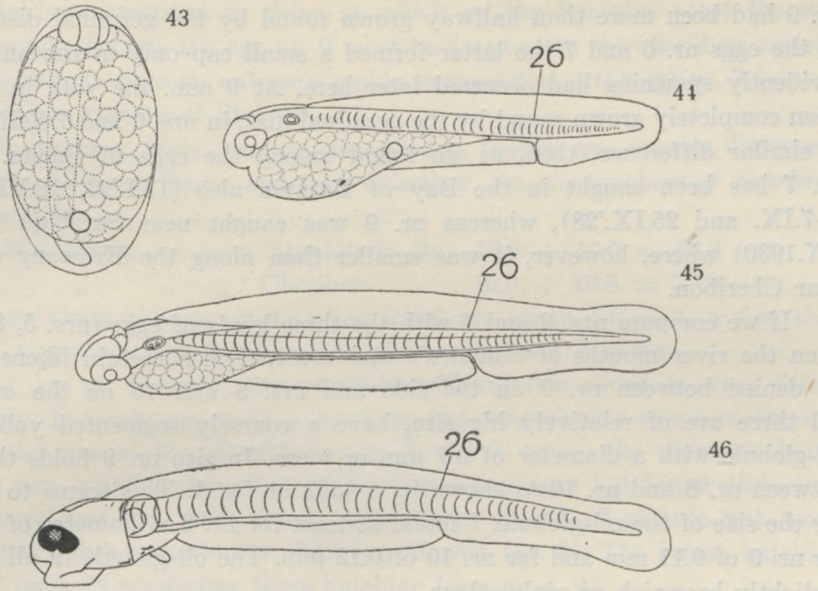

Fig. 43. The egg nr. 9, at 1 p.m., × 26.
Fig. 44. Newly hatched larva, 7 p.m., × 26.
Fig. 45. Larva of the next morning, 6.30 a.m., × 26.
Fig. 46. Larva of the second morning, 6.30 a.m., × 26.

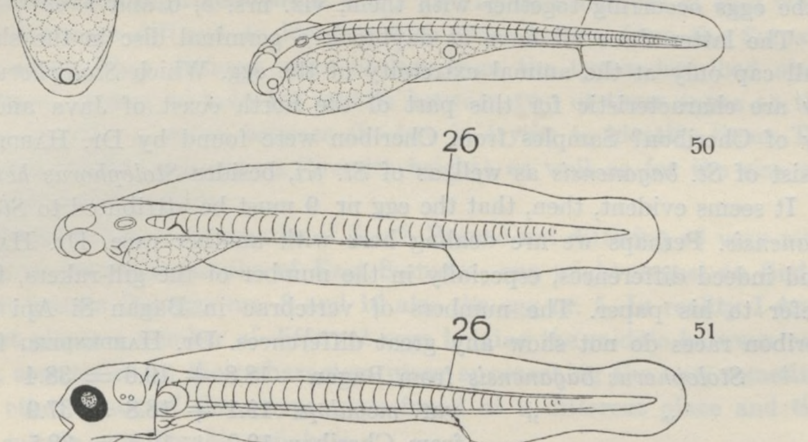

Fig. 47. The egg nr. 7, at 9 a.m., × 26.
Fig. 48. Newly hatched larva, 6 p.m., × 26.
Fig. 49. Larva at 9 p.m., × 26.
Fig. 50. Larva of the next morning, 9.30 a.m., × 26.
Fig. 51. Larva of the second morning, 9.30 a.m., × 26.

nr. 9 had been more than halfway grown round by the germinal disc, whereas in the eggs nr. 6 and 7 the latter formed a small cap only at the animal pole. Evidently spawning had occurred later here. At 9 a.m. the yolk in nr. 9 has been completely grown round by the germinal disc, in nrs. 6 and 7 halfway only. A similar difference, then, as we found among the eggs of Bagan. The egg nr. 7 has been caught in the Bay of Batavia also (11.I.'23, 18.VII.'24 and 6.-7.IX. and 25.IX.'28), whereas nr. 9 was caught near Surabaja (8.V. and 6.X.1930) where, however, it was smaller than along the Krawang coast and near Cheribon.

If we compare nrs. 9 and 7 with the three kinds of eggs (nrs. 5, 8 and 10) from the river mouths of Sumatra's east coast, then a certain likeness cannot be denied between nr. 9 on the side and nrs. 8 and 10 on the other side. All three are of relatively big size, have a coarsely segmented yolk and an oil-globule with a diameter of 0.1 mm or more. In size nr. 9 holds the middle between nr. 8 and nr. 10 as shown by a look at fig. 1. This seems to hold also for the size of the oil-globule. I found at least for nr. 8 a diameter of 0.10 mm, for nr. 9 of 0.11 mm and for nr. 10 of 0.12 mm. The oil-globule in all three has a slightly brownish or pink colour.

Another point of similarity is the advanced stage of development of these eggs at daybreak. We have seen that in nr. 10 the blastopore just closed at daybreak and the rudiment of the embryo reaches from one pole of the egg to the other. In nr. 9 the germinal disc at 6 a.m. has grown more than halfway round the yolk and the blastopore closes at 8 a.m. The egg nr. 8, truly, is somewhat later. At 6 a.m. the germinal disc has grown round only ⅓—¼ of the yolk, at 8 a.m. about ¾, and closing of the blastopore will find place about an hour later than with nr. 9. In this respect also nr. 9 holds the middle between nrs. 8 and 10. In all three, however, the stage of development is further than in the eggs occurring together with them, viz. nrs. 5, 6 and 7.

The latter three all have at daybreak a germinal disc in the shape of a small cap only at the animal extremity of the egg. Which *Stolephorus* species now are characteristic for this part of the north coast of Java and for the Bay of Cheribon? Samples from Cheribon were found by Dr. HARDENBERG to consist of *St. baganensis* as well as of *St. tri*, besides *Stolephorus heterolobus*.

It seems evident, then, that the egg nr. 9 must be attributed to *Stolephorus baganensis*. Perhaps we are dealing here with another race. Dr. HARDENBERG found indeed differences, especially in the number of the gill-rakers, for which I refer to his paper. The numbers of vertebrae in Bagan Si Api Api and Cheribon races do not show any great differences. Dr. HARDENBERG found for

Stolephorus	*baganensis*	from Bagan	18.8 + 19.6 = 38.4
„	„	var. *megalops*	19.1 + 18.8 = 37.9
„	„	from Cheribon	19.0 + 19.5 = 38.5
„	„	from Batavia	19.0 + 19.4 = 38.4

I have not often determined the salinity of the water in which the egg nr. 9 was fished. On April 25th, 1929, I found 29.6‰, on May 7th, 1925, 31.5‰.

These salinities correspond to those at which on the Sumatra coast the egg nr. 10 is found. If, then, the egg nr. 9 must be ascribed to the Cheribon variety of *Stol. baganensis*, it seems only reasonable to suggest that the egg nr. 7 belongs to the Cheribon variety of *Stol. tri.*

Dr. HARDENBERG, truly, has not succeeded in finding any notable difference between *Stol. tri* from Bagan and from Cheribon. For the numbers of vertebrae e.g. he found in

Stolephorus tri·from Amphitrite Bay 19.0 + 19.0 = 38.0
" " " Cheribon 19.0 + 18.8 = 37.8.

The two kinds of eggs, on the other hand, are fairly different in size, that of Bagan being much broader than that of Cheribon and Batavia.

In the egg nr. 5, truly, the length-breadth-relation seems to vary fairly considerably. It rarely approaches, however, the very slender shape of the egg nr. 7. In the size of the oil-globule nrs. 5 and 7 agree, the diameter being 0.07—0.08 mm, smaller than that of the *baganensis*-eggs but larger than that of the *heterolobus*-egg. And also in the colour of the oil-globule not being brownish but either colourless or slightly yellowish (nr. 5). The larvae hatching from nr. 7 have 26 myotomes, those hatching from nr. 5 25.

Although the positive indications are few in number and value, I see no other way than assuming that the egg nr. 7 belongs to *Stolephorus tri.*

I have distinguished, then, and recognized in the catches again and again, three varieties of *Stolephorus* eggs with an oil-globule from the east-sumatran rivermouths (nrs. 8, 9 and 10) and three from the coast of Java (nrs. 5, 6 and 7).

Afterwards I have extended my investigations to the river mouths of the south coast of Borneo, i.e. those of the Kumai, the Sampit and the Barito river. Here I found eggs which seemed to me to be identical with nrs. 8 and 10, i.e. the eggs of the two varieties of *Stolephorus baganensis* occurring in the Rokan mouth and neighbouring rivermouths. But I also found a number of eggs which seemed to me more difficult to identify with those known from the Sumatra and Java coast. They differed more or less from the types described above and sometimes seemed to hold the middle between two of these types so that I hesitated to make a choice between the two in trying to identify them. This holds for the relative dimensions (breadth-height) as well as for the size and the colour of the oil-globule.

Conditions in the river mouths of South Borneo not differing so very much from those in the river mouths of East Sumatra, one might expect to find in the former, besides the eggs nrs. 8 and 10 also the egg nr. 5. In reality I found at different places a number of different eggs holding the middle between nr. 5 and nr. 9, sometimes in their characters more approaching the one, sometimes more the other. Each of these types was found at a different place and time and as a rule in considerable numbers.

They resemble nr. 5 in that the diameter of the oil-globule is never more than 0.7—0.8 mm. In some the oil-globule was slightly colourless or yellowish, as in nr. 5 (*Stolephorus tri*). In other samples, however, it had that brownish

or pink tinge which is characteristic of nrs. 8, 9 and 10 (*Stolephorus baganensis*).

Although the colour of the oil-globule is characteristic in many cases, yet it seems doubtful if we may attribute too much value to it. Thus the oil-globule of the egg nr. 8 is in general brownish but, as mentioned above, one may sometimes find specimens with an oil-globule of as clear a yellow as that of the egg nr. 6. No transitions between the two were found so that possibly we are dealing with a separate variety. But no other difference was found, not even in the number of myotomes of the larvae hatching from them, so that I am in doubt what to think about this.

I will first give now a list of the different eggs met at various occasions and holding the middle between or differing slightly from nrs. 5, 7 and 9.

52

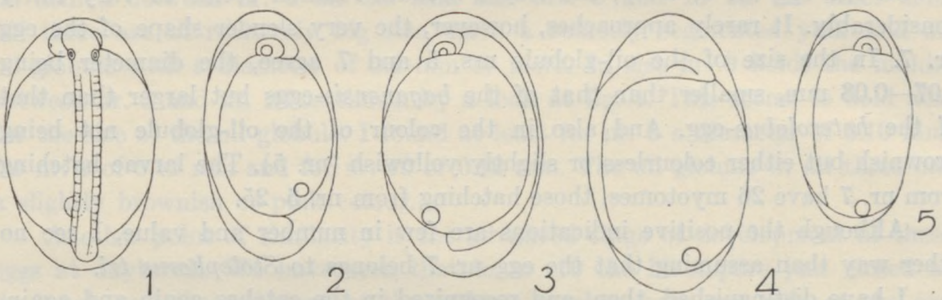

Fig. 52. Eggs from the Koemai-, Sampit- and Barito-mouths (South coast of Borneo).

Mouth of the Koemai (Borneo).

September 30th, 1928.

Dimensions 1.3 × 0.7^5 mm; oil-globule 0.07 mm, slightly yellowish.

Trunk myotomes of the larva 27 (Fig. 52 nr. 1).

April 26th, 1930.

Dimensions 1.2 × 0.66 mm; oil-globule 0.07 mm, slightly brownish.

Trunk myotomes of the larva 26—27 (Fig. 52 nr. 2).

April 27th, and September 30th, 1930.

Dimensions 1.3 × 0.8 m; oil-globule 0.07^5 mm, slightly yellowish or colourless.

Trunk myotomes of the larva 27—28 (Fig. 52 nr. 3).

Mouth of the Sampit (Borneo).

April 26th, 1930.

Dimensions 1.2^5 × 0.7 mm; oil-globule 0.07^5 mm, brownish.

Myotomes of the larva 27½—28 + 12 = 39½—40.

April 29th, 1930.

Dimensions 1.38 × 0.83 mm; oil-globule 0.07^5 mm, brownish.

Trunk myotomes of the larva 28 (Fig. 52 nr. 4).

Mouth of the Barito.

October 3rd, 1928.

Dimensions 1.1^5 × 0.6 mm; oil-globule 0.07^5 mm, slightly yellowish.

Trunk myotomes of the larva 27 (Fig. 52, nr. 5).

These are the observations of the south coast of Borneo. Also along the coast of Sumatra I have sometimes found somewhat diverging types of which the description is as follows.

Bengkalis.

J a n u a r y 9—10th, 1929.

Dimensions 1.2 × 0.72 mm; oil-globule 0.06^5—0.07^5 mm, colourless or slightly yellowish.

Amphitrite-Bay.

S e p t e m b e r 27th, 1929.

Dimensions 1.17 × 0.57 mm; oil-globule 0.07^5 mm, slightly yellowish.

Trunk myotomes of the larva 27.

Finally I mention a few eggs found near Surabaya:

Surabaya.

M a y 8th, 1930.

a. Dimensions 1.2 × 0.63 mm; oil-globule 0.06^5 mm, slightly yellowish.

Trunk myotomes of the larva 26.

b. Dimensions 1.17 × 0.73 mm; oil-globule 0.09—0.09^5 mm, brownish.

Trunk myotomes of the larva 26.

Of these two varieties the latter corresponds fairly well to nr. 9 and is mentioned as such on p. 236. The first named seems to resemble most the egg nr. 5. Also the number of trunk myotomes of the larvae tallies very well with what we found for the latter egg.

This is not the case with several of the dubious eggs mentioned above from the south coast of Borneo and the east coast of Sumatra. Here the number of trunk myotomes is often 27 and sometimes even amounts to 28, a number never found in any of the other eggs with an oil-globule.

Must we think here of another species of the *tri-baganensis*-group? Dr. Hardenberg has found such a species in the Bay of Batavia, but always young specimens only. The average number of vertebrae is 20 + 19.4 = 39.4, i.e. one trunk vertebra more than is the rule with *Stol. tri.* No mature specimens, however, of this species have thus far been found.

From the south coast of Borneo (Kumai mouth) Dr. Hardenberg got some samples of *Stolephorus* species which he found to consist of *Stolephorus indicus*, *commersonii* and *insularis* (eggs all with a knob) and of *Stolephorus tri* and *baganensis.* The short and thick *baganensis*-eggs were found in the inland part of the estuary, so that only *Stol. tri* remains for the other eggs.

In general, then, our impression is that variability is greatest among the *Stolephorus*-eggs with an oil-globule, i.e. those belonging to the coast forms, which evidently have thus far been called collectively *Stolephorus tri.* Closer investigation would probably show that this species should be split up into a number of local races or varieties. *Stolephorus baganensis* e.g. is clearly different from *Stol. tri* and is a.o. characterized by the fact that the number of trunk vertebrae is lower than that of the tail vertebrae (with the exception of the var. *megalops*). One sometimes get the impression that nearly every river mouth

has its own local race or races. It is also very remarkable, how much richer the fauna of one river mouth is when compared with the other.

That of the Rokan and Panei mouths e.g. is very rich, that of the Musi mouth seems to be much poorer. Fishery is of much less significance here and also the pelagic fish eggs are much rarer. In a series of horizontal hauls made while approaching and entering the Musi mouth I did not find one *Stolephorus* egg with an oil-globule, not even when the salinity was getting such that in the mouths af the Indragiri, Rokan and Panei-rivers eggs of *Stolephorus tri* and *baganensis* certainly would have been present. Only in the outer catches, where the salinity was 30‰ or more, the eggs of *Stolephorus zollingeri* were numerous. A sample of i k a n t e r i from Muntok (island of Bangka, opposite the Musi mouth) proved indeed to consist of this species. The characteristic river mouth species, however, i.e. those with an oil-globule, seem to be absent in the Musi mouth, as is apparently the case with other fish species characteristic of the Rokan and Indragiri mouths. A study of the different river mouths round the Java Sea and of their fauna would be very interesting and would probably reveal considerable differences.

We have, then, fairly well succeeded in identifying at least the principal types of *Stolephorus* eggs. The results may be briefly summarized as follows:

1° Eggs without oil-globule and with a knob on the egg-membrane.
- *a* longer variety (fig. 1, nr. 3). *Stolephorus insularis*
- *b* shorter „ (nr. 4). „ *indicus* or *commersonii*

2° Eggs without a knob and without oil-globule or with a very small oil-globule (diameter 0.05 mm).
- *a* without an oil-globule (nrs. 1, 2) *Stolephorus zollingeri*
- *b* with a small, yellow oil-globule (nr. 6) „ *heterolobus*

3° Eggs without a knob, and with an oil-globule of 0.07^5—0.12 mm diameter.
- *a* diameter of oil-globule 0.07—0.08 mm (nrs. 5, 7) *Stolephorus tri*
- *b* „ „ „ „ 0.10—0.12 mm (nrs. 8, 10) „ *baganensis*

With all these eggs the incubation period is evidently less than 24 hours. Spawning, like in many other fishes, occurs in the course of the night, probably a few hours before midnight [1]). Hatching may occur as early as 2—2.30 p.m. (nr. 10), but as a rule finds place at 5—7 p.m. The stage at which the eyes get black is reached in the second night after hatching. In nr. 3, however, this stage is reached in the third night only, in nr. 4 in the course of the second day.

As regards the older stages of development, they are often found in great number in the catches. Distinction of the different species, however, becomes practically impossible. The number of trunk myotomes, e.g., diminishes with growing age, as we have seen, and thus cannot be relied upon. There are hardly any other characteristics by which to distinguish the different species. One particularity must be mentioned here.

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[1]) HILDEBRAND (l.c.) finds for *Anchoviella epsetus* about 8 o'clock in the evening.

In *Stolephorus* larvae from Bagan with a length of from 18 to 24 mm, I observed a yellow-brownish colour in the root of the tail fin and a similar spot just behind the anus. In younger larvae they are not yet present and in older ones this colour disappears again. Each of these coloured areas makes the impression of not being caused by the presence of pigment cells but of a homogeneous coloured fluid. In larvae from other places and evidently belonging to other species I found in the same places, viz. at the tail root and just behind the anus, similar coloured areas but of a different colour. This colour was pink in *Stolephorus* larvae caught near Labuan (Sunda Strait), violet in other larvae fished near Bagan Si Api Api, and crimson in larvae caught near Tjimara (coast of Krawang, near Batavia). These different colours might allow us to distinguish the larvae of different species. But as they are present in larvae of a definite size only and moreover disappear in preserved specimens, it seemed to me not worth while to enlarge upon this matter any further.

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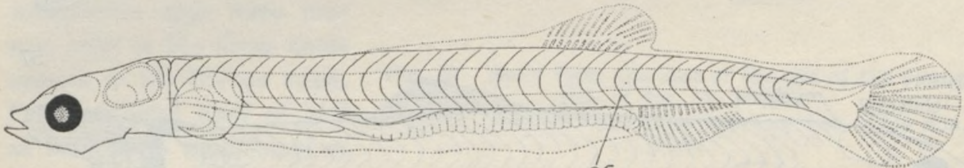

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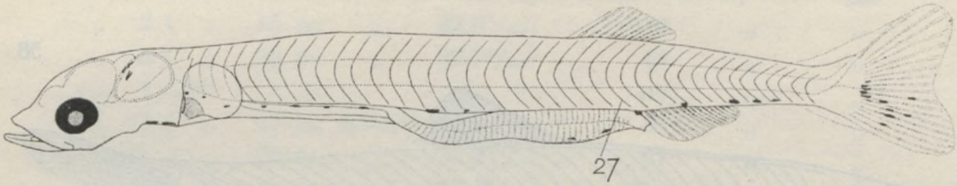

Fig. 53. *Stolephorus baganensis.* **Larva from the plankton, mouth of the Panei-river, 5.X.1929. Length about 8 mm.**
Fig. 54. **Similar larva of another** *Stolephorus* **species, caught east of the Thousand Islands, length 8,4 mm.**

A few larvae of different lengths, as they are caught regularly in the egg-net, are shown in figs. 53—58. The smallest of these (fig. 53) belongs to *Stolephorus baganensis,* being caught together with the short and thick eggs of this species and in the brackish water where the eggs are found. The unpaired fins are developing and the number of pre-anal myotomes is 26, i.e. the same as in the newly hatched larvae. Fig. 54 represents a larva of 8.4 mm. It has 27 pre-anal myotomes and thus probably belongs to one of the less neritic species, with no oil-globule in the egg. It was caught also at some distance from the coast, between the Thousand Islands.

The larvae of figs. 55, 56, 57 and 58 probably all belong to *Stolephorus tri.* They were caught between the outer jeremals of Bagan Si Api Api, where the above named species is the most common. A comparison shows that the ventral

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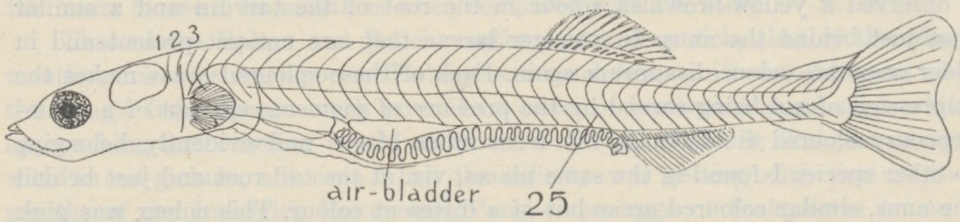

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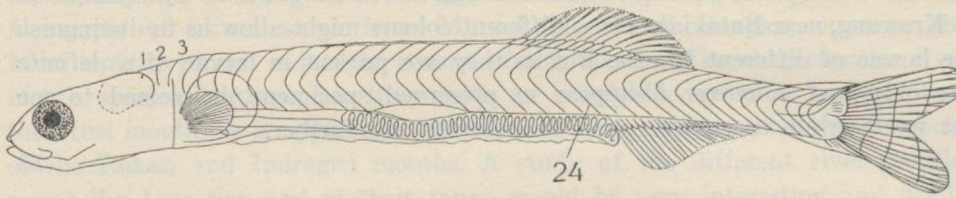

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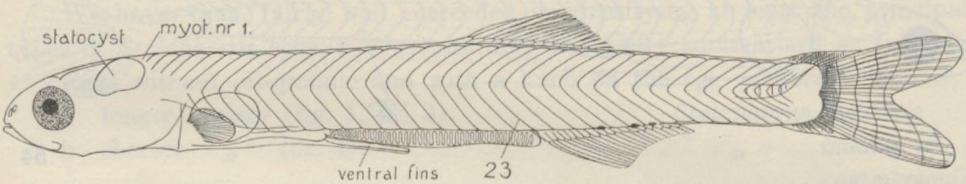

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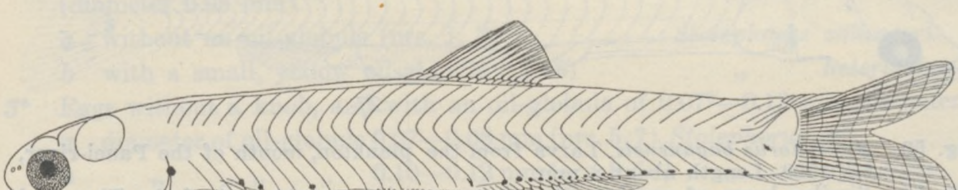

Fig. 55. Larva of *Stolephorus tri*? Caught between the outer jeremals of Bagan Si Api Api, length 8⅔ mm. June 1923.
Fig. 56. Similar young fish of 11½ mm.
Fig. 57. Similar young fish of 18 mm., with small scales on the root of the tail.
Fig. 58. Similar young fish, wholly scaled, of 25½ mm.

fins begin to develop at a stage of somewhat less than 18 mm. At about the same stage the peculiar brownish colour of the root of the tail fin and behind the anus appears. The number of pre-anal myotomes decreases quite gradually, so does the number of myotomes between the ventral fins and the anus after the former have appeared.

The maxillary lengthens to behind the eye. Small scales appear first at the end of the tail in the stage of fig. 57. Such a scale is represented in fig. 59.

In the stage of fig. 58 the whole body is scaled. Fig. 60 shows the scale of a fish of 24 cm length.

The study of the distribution of the *Stolephorus* eggs shows that the species of *Stolephorus* are all more or less restricted to a zone along the coast. In the centre of the Java Sea, e.g., no or hardly any *Stolephorus* eggs are to be found (the only exception being occasionally the egg nr. 2).

In September of the year 1928 I made a series of surface hauls with the egg net, reaching in a straight line from the mouth of the Tjimanoek (north coast of Java) to the mouth of Koemai (south coast of Borneo). There were 27 stations in all. *Stolephorus* eggs were present only in the three hauls nearest to the Borneo coast. Per horizontal haul of half an hour there were found at

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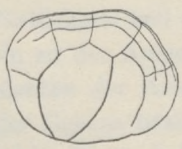

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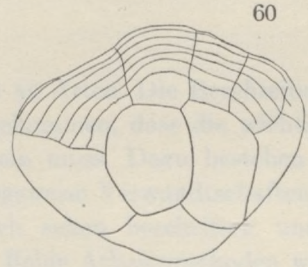

Fig. 59. Scale from the root of the tail of the young fish of fig. 57, × 26.
Fig. 60. Similar scale from a young fish of 24 mm, × 26.

Station						
nr. 1	(depth	20 m,	salinity	32.2‰)	3810	*Stolephorus* eggs
„ 2	(„	15 m,	„	32.6‰)	310	„ „
„ 3	(„	32 m,	„	32.7‰)	45	„ „
„ 4—23					no	„ „
„ 24	(„	27 m,	salinity	33.9‰)	33	„ „
„ 25	(„	20 m,	„	33.8‰)	67	„ „
„ 26	(„	14 m,	„	33.3‰)	210	„ „
„ 27	(„	8 m,	„	32.9‰)	580	„ „ .

In a similar series of hauls made in April 1930 and consisting of 34 hauls, *Stolephorus* eggs proved to be absent in the catches nrs. 7—26. Only in May 1931 I found nr. 2 also in the middle of the Java Sea.

The *Stolephorus* population evidently forms a belt along the coast line and within this zone the eggs without an oil-globule — mainly those of *Stolephorus zollingeri* and *insularis* (nrs. 1, 2 and 3) — are found more seaward, those with an oil-globule — belonging to *Stolephorus heterolobus, tri* and *baganensis* — more landward.

ZUR KENNTNIS DER LYCIDENFAUNA JAVAS.

Von

R. KLEINE

(Stettin).

Die *Lycidae* ist arm an Gattungen und reich an Arten. Die Beschreibungen sind weit zerstreut und ich bin zu der Ansicht gekommen, dass die wichtigsten und nächsten Arbeiten das sichten der Arten sein muss. Dazu bestehen zwei Möglichkeiten: Bearbeitung der Genera beziehungsweise Verwandtschaften oder faunistische Uebersichten. Beide Wege habe ich schon beschritten und die Ergebnisse sind durchaus befriedigende gewesen. Beide Arbeitsmethoden werden künftigen Bearbeitern von Vorteil sein. Den Anstoss zu vorliegender Arbeit gaben vor allen Dingen die schönen Ausbeuten, die Herr F. C. Drescher gemacht hat und die einen recht guten Einblick in die Fauna Javas gestatten. Zweifellos ist die Lycidenfauna Javas nur zum Teil bekannt, aber in den Ausbeuten scheinen mir die neuauftretenden Arten doch schon geringer zu werden, so dass die vorläufige Registrierung der bekannten Arten wohl berechtigt erscheint.

Die zoogeographische Stellung Javas zu den anderen Sundainseln.

Nach meinen langjährigen Studien an Brenthiden bin ich zu folgendem Ergebnis gekommen: Malakka muss früher mit Sumatra, nicht mit dem asiatischen Landmassiv zusammengehangen haben, die Trennung lag etwa am 10. Breitengrade. Die Fauna Malakkas und Sumatras ist ganz homogen. Grosse Aehnlichkeit mit Sumatra hat die Fauna Borneos, der Zusammenhang beider Inseln muss lange gedauert haben. Man kann annehmen, dass Malakka-Sumatra-Borneo ein in sich geschlossenes Landmassiv gewesen ist. Dem steht Java mit einer um vieles ärmeren und abweichenden Fauna gegenüber. Arldt [1]) bestätigt meine Ansichten. Nach seiner Meinung hat die Inselwelt Indiens im Miozän ein geschlossenes Festlandsgebiet gebildet, dass sich wenigstens bis zur Molukkenstrasse, zur Banda- und Arafura-See erstreckt hat. Arldt sagt a.a. O.: „Von den grossen Inseln ist Sumatra sicher die jüngste, die erst spät im Quartär von der Halbinsel Malakka abgetrennt sein kann". Sumatra ist nach seiner Ansicht später isoliert, als das faunistisch sehr ähnliche Borneo. Die Trennung der einzelnen Inseln denkt sich Arldt a.a.O. p. 545 so: „Das Festland hätte hiernach zunächst bis zur Molukkenstrasse, Molukken-, Banda- und Timorsee gereicht, während die Molukken, Kei, Aru, Tenimber und Babber mit Australien verbunden waren. Nach den Tiefen müsste sich dann Borneo eher abgetrennt haben als Java und die Sundainseln bis Alor." Das letztere erscheint ihm fraglich. Auf die

[1]) Handbuch der Palaeogeographie Band I, Leipzig 1919, p. 625.

Verschiedenheit der Fauna Javas von den anderen grossen Sundainseln weist der Verfasser hin. Nach der Isolierung Javas von Sumatra konnte die lebende Fauna zwar nach Norden, nach Malakka also, zurückwandern, Java aber blieb isoliert, der Rückweg war verschlossen. Borneo soll sich früher von Java getrennt haben als Sumatra. Die Abtrennung Javas soll von Osten nach Westen vorgeschritten sein. ARLDT ist der Ansicht, dass die kleinen Sundainseln sehr zeitig von Java getrennt seien, wohl schon im Unterpliozän.

Alles hier Gesagte hat sich bei den Brenthiden als richtig erwiesen: grosse Aehnlichkeit der Fauna von Sumatra-Malakka, starke Anlehnung Borneos hieran, Isolierung Javas, Artenarmut, die auf den kleinen Sundainseln noch zunimmt.

Die hier von ARLDT skizzierte, durch meine Brenthidenstudien voll und ganz bestätigten Darstellungen treffen auch für die Lyciden sicher in den wesentlichsten Punkten zu. Allerdings eignen sich die Lyciden zu zoogeographischen Studien weniger als die Brenthiden, sie sind weniger scharf in Gattungen und Arten trennbar und vor allen Dingen: sie haben alle eine mehr oder weniger auffallend geringe Migrationsneigung und sind sicher viel häufiger lokal als man annimmt. Im grossen und ganzen sprechen meine Erfahrungen aber nicht gegen die ARLDT'sche Darstellung. Es ist anzunehmen, dass die Zahl der Endemismen auf Java sehr gross ist. Das trifft auch zu. Wenn die nachstehenden Zahlen auch nur ein unvollkommenes Bild geben, so lassen sie doch schon erkennen, dass nur wenige Arten sich einer weiteren Verbreitung erfreuen.

VERBREITUNG DER HIER BEHANDELTEN ARTEN [1]).

Nur von Java sind bekannt	126	Arten
Java-Sumatra	4	„
Java-Borneo	5	„
Java-Sumatra-Borneo	1	„
Java-Penang	4	„
Java-Andamanen (?)	1	„
Java-Molukken	2	„
Java-Sumatra-Borneo-Molukken	7	„

Das Verhältnis der Endemismen zu den weiter verbreiteten Arten ist demnach 124: 24.

Das gleichzeitige Vorkommen auf mehreren grossen Sundainseln bedarf keiner Erklärung. Die Zahl der Arten die Java mit Borneo oder Sumatra gemeinsam hat, ist fast gleich gross. Etwas unwahrscheinlich scheinen mir die Angaben, dass Java mit Malakka ohne Berührung Sumatras artlich verbunden sein soll. Von den in Frage kommenden Arten hat mir Material genug vorgelegen, es müsste sich doch einmal ein Vertreter auf der Zwischenstation gefunden haben. Das ist aber nach meiner Erfahrung nicht der Fall, und dabei handelt es sich um häufige Arten. Es müssen artlich sehr ähnliche Arten, und um solche handelt es sich, erst noch genau untersucht werden. Unsicher ist auch die auf Java

[1]) Die im Anhang beschriebenen Arten sind hier mit aufgezählt. — Red.

und den Andamanen lebende Art, die Art ist für Java mit Fragezeichen zu versehen.

Es wirkt auf den ersten Augenblick etwas befremdend, dass Lyciden auf Java und den Molukken vorkommen sollen. Aber gerade hier habe ich durchaus sicheres Material in Händen gehabt, es sind einwandfreie Belege vorhanden. Die in Frage kommenden Arten haben keine Doppelgänger und sind leicht erkennbar. Es ist beachtlich, dass 7 Arten von Sumatra bis zu den Molukken festgestellt worden sind, allerdings nicht auf denjenigen Inseln, die nach Ansicht der Paleogeographen zum australischen Landmassiv zu rechnen sind.

FORMEN DES HOCH- UND TIEFLANDES.

Die Exploration höherer Gebirge von MJÖBERG auf Borneo hatte die überraschende Tatsache erbracht, dass im Gebirge ganz anders ausgefärbte Arten wohnen als in der Ebene. Ich habe darüber ausführlich berichtet. [1]) Für Java liegen derartige Beobachtungen nicht vor, obwohl Lyciden aus gleicher Höhenlage bekannt sind, wie sie MJÖBERG von Borneo angegeben hat. Leider ist das zur Verfügung stehende Material noch zu lückig um urteilen zu können. Soviel ist aber nach den bisherigen Erfahrungen zu sagen, dass in der Farbenverteilung sich zwischen Höhen- und Tiefenformen keine Differenzen haben feststellen lassen.

LISTE DER AUFGEFUNDENEN LYCIDEN.

Lycinae.

Lycostomus MOTSCHOULSKY.

Bull. Soc. Imp. Nat. Moscou 1861, p. 136.

kerni n. sp. (Fig. 1).

Abdomen, mit Ausnahme des dunklen letzten Segmentes hellgelbbraun, Brust dunkler, Beine dunkelbraun, fast schwarzbraun, Schenkelbasis nicht heller, Kopf gelbbraun, 1. und 2. Fühlerglied hellbraun, 3. bis 5. hellgelb, an den Innenkanten dunkler, nach den vorderen Gliedern wird die Färbung dunkler, die Spitzenglieder sind schwarzbraun, Prothorax, Schildchen und Elytren hell lehmgelb, Hinterrand schwarz. — Rüssel doppelt so lang als breit, Stirn mit 2 punktförmigen Eindrücken, Fühlerbeulen flach. — Fühlerglieder 6.—10. von gleicher Gestalt wie das 5., 11. länger als das 10. — Punktierung des Prothorax flach. — Auf den Elytren sind alle Rippen deutlich vorhanden, aber nur schwach entwickelt, Skulptur unscharf und durch die Behaarung bedeckt.

Länge: 12 mm, Breite (hum.): 3,5 mm.

Java. (HORSFIELD).

1 ♂. Typus im Britischen Museum.

Die neue Art ist meinem Freunde P. KERN-Halle a/S. gewidmet.

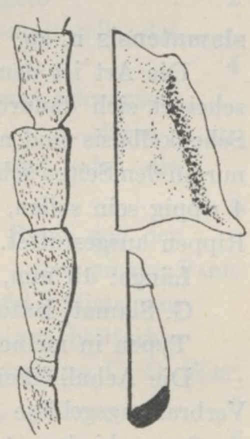

Fig. 1. *Lycostomus kerni*, n. sp. 1.—5. Fühlerglied, Prothorax und Farbenverteilung.

[1]) Stett.Ent.Zeit. 89. 1928, p. 313 ff.

Kerni sieht einem schlanken *analis* DALM. ähnlich und hat keinen Konkurrenten auf den Sunda-Inseln. Sie unterscheidet sich leicht durch die dunklen Beine und anderen Fühler, namentlich sind die basalen Glieder viel schlanker.

ferrugineus FABR.
Ent. Syst. Suppl. p. 125.

Eine in der Ausfärbung recht variable Art. Auf den Elytren kann die Schwarzfärbung am Hinterrand gänzlich fehlen. Meist ist sie aber, allerdings immer nur ganz schwach, vorhanden. Die Art is häufig. Ich sah folgende Fundorte: West Java: G. Gedeh 4000′; Pengalengan 4000′; G. Tjikorai (FRUHSTORFER); Pelaboean Ratoe (Mus. Buitenzorg); Buitenzorg (WARBURG); Preanger (SIJTHOFF); Ins. Noesa Kambangan; Patimoean (S. Preanger, DRESCHER). Ost Java: Lawang (FRUHSTORFER); G. Oengaran; Malang.

angustatus C. O. WAT.
Ill. Typ. Spec. Col. Lycid.I,1879,p.15,Taf.III,Fig.9.

Der Autor gibt keinen näheren Fundort an. Ich selbst habe in dem mir vorliegenden Material die Art noch nicht aufgefunden. Sie ist in der Ausfärbung recht typisch und lässt sich nicht übersehen. Es dürfte sich um eine nicht häufige Art handeln.

waterhousei BOURGEOIS.
Ann.Mus.Civ.Stor.Nat.Gen.XVIII,1883,p.626.

Die Art ist in der Ausfärbung sehr variabel, sodass sich die artlichen Grenzen nicht ganz leicht feststellen lassen. Ausser von Java ist sie von Sumatra bekannt, wo sie nicht gerade selten zu sein scheint. Auf Java ist sie nicht häufig. Ich sah bisher nur einen Fundort: G. Patoeha 5000′ Preanger (DRESCHER). Die Höhenform unterschied sich von den Tieflandstieren in keiner Weise.

slamatensis n. sp.

Die Art ist dem *elongatulus* BOURG. von Burmah sehr ähnlich. Sie unterscheidet sich dadurch, dass die Beine von schwarzer Farbe sind, Hüften und Schenkelbasis sind nicht rötlich, ebenso ist das Abdomen einfarbig schwarz und nur an den Seiten schwach rot behaart. Die Elytren, die bei *elongatulus* unscharf-4 rippig sein sollen, sind bei der neuen Art mit 4 sehr deutlich durchgehenden Rippen ausgestattet.

Länge: 15 mm, Breite (hum.): 4 mm.

G. Slamat, Batoerraden (DRESCHER).

Typen in meiner Sammlung.

Die Aehnlichkeit mit *elongatulus* ist zweifellos sehr gross, aber schon die Verbreitungsgebiete Java-Burmah lassen den Verdacht aufkommen, dass es sich um 2 verschiedene Arten handelt. Aus dem indischen Gebiet sind keine Lyciden auf die Sunda-Inseln übergegangen.

drescheri n. sp. (fig. 2).

Tiefschwarz mit blauem Schimmer, der namentlich an den Beinen auf-

fallend is, Elytren ziegelrot, am ganzen Körper hochglänzend, nur die Elytren matt. — Stirn über den Fühlerbeulen mit 2 tiefen Punkten, Rüssel doppelt so lang als an der Basis breit, punktiert und behaart. — Fühler zart, 3. Glied kürzer als das 4. und 5. zusammen, 4.—11. länger als breit, ungezahnt, vom 4.—10. an Länge und Breite abnehmend, 11. länger als das 10. Behaarung kurz und dicht. — Prothorax breiter als lang, Seiten mittelstark aufgebogen, Hinterecken stumpf, am Vorderrand gekielt, Kiel in eine durchgehende Mittelfurche fortgesetzt, Randpunktierung grob und flach, durch Behaarung verdeckt. — Schildchen kurz, keilförmig, Hinterrand gerade. — Elytren mit sehr schwachen, aber deutlichen Rippen, die grobe unregelmässige Skulptur durch dichte Behaarung verdeckt.

Fig. 2. *Lycostomus drescheri*, n. sp. Prothorax und mittleres Fühlerglied.

Länge: 17 mm, Breite (hum.): 4 mm.

Java: G. Tangkoeban Prahoe 4—5000′ Preanger 10.VI.29 (DRESCHER).

1 ♀ Typus in meiner Sammlung.

Ich widme die schöne Art dem Sammler. Von allen javanischen Arten durch die Ausfärbung leicht zu trennen, auch mit anderen Arten des orientalischen Gebietes besteht keine Uebereinstimmung.

vulpinus C. O. WAT.

Ill. Typ. Spec. Col. Lycid. I, 1879, p.11, Taf.II, Fig.8.

Der Autor beschreibt die Art aus Sumatra. Ich sah sie auch in sicheren Stücken von Java, leider ohne nähere Fundortangabe.

UEBERSICHT ÜBER DIE ARTEN.

1. Grundfarbe der Körperoberseite lehmgelb bis schmutziggelb 2
   Grundfarbe orangerot, ziegelrot in allen Abstufungen, niemals gelb oder in ähnlichen Farbentönungen 4
2. Elytren hell-lehmgelb mit mehr oder weniger breitem schwarzem Hinterrand . . . . *kerni* n. sp.
   Elytren schmutzig-lehmgelb ohne schwarzen Hinterrand oder die Schwarzfärbung ist nur in Spuren angedeutet 3
3. Grosse Art, ca. 20 mm und darüber, Prothorax quer, Beine wie der ganze Unterkörper schwarz . . . . *ferrugineus* FABR.
   Kleine Art, 10—12 mm, Prothorax schlank, trapezoid, Mitte nur schwach, unscharf verdunkelt, Beine mehr oder weniger hellfarbig *angustatus* C. O. WAT.
4. Elytren mit schwarzem Hinterrand 5
   Elytren ohne schwarzer Zeichnung 6
5. Prothorax höher als breit . . . . *waterhousei* BOURG.
   Prothorax breiter als hoch . . . . *slamatensis* n. sp.
6. Prothorax breiter als lang, am Vorderrand nicht spitz vorgezogen *drescheri* n. sp.

Prothorax dreieckig, am Vorderrand spitz vorgezogen 7

7. 4.—10. Fühlerglied tief gezahnt, Prothorax an den Seitenrändern stark aufgebogen . . . . *baliensis* n. sp. (Siehe p. 291).

4.—10. Fühlerglied nicht gezahnt, Seitenränder des Prothorax nicht aufgebogen . . . . *vulpinus* C. O. WAT.

Dictyopterinae.

Coloberos BOURGEOIS.

Ann. Soc. Ent. Fr. 1885, p. 82.

costatus PIC.

Hors texte Ech.Nr.407, 1922, p. 13.

Keine nähere Fundortangabe. Ich sah die Art nicht.

Pyropterus MULSANT.

Soc. Agr. Lyon, 1838,I,p.81,Taf.5,Fig.6.

incisus PIC.

Hors texte Ech. Nr. 419, 1925, p. 6.

Keine nähere Fundortangabe. Ich sah die Art nicht.

sculpturatus C. O. WAT.

Trans. Ent. Soc. 1878, p. 112.

Der Autor beschreibt die Art von Borneo (Sarawak). Ich fand sie sicher unter javanischem Material: G. Tangkoeban Prahoe 4—5000′ Preanger (DRESCHER).

UEBERSICHT ÜBER DIE ARTEN.

Von gedrungenem Körperbau, Prothorax schwarz . . . . *sculpturatus* WAT.

Von schlankem Körperbau, Prothorax zum Teil gelb . . . . . . *incisus* PIC.

Protaphes KLEINE.

Saraw. Mus. Journ. III,(3),Nr.10,1926,p.363.

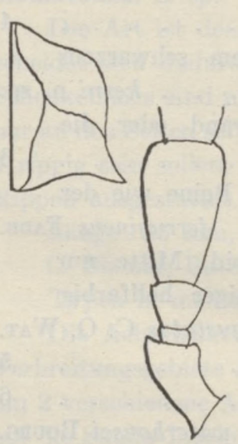

Fig. 3. *Protaphes drescheri*, n. sp. Prothorax und 1.—3. Fühlerglied.

drescheri n. sp. (Fig. 3).

Schwarz, Prothorax, Schildchen und Elytren strohgelb. — Stirn vor den Fühlerbeulen stark vertieft, die Vertiefung läuft als Rinne seitlich bis unter die Augen, Fühlerbeulen gross, Behaarung kurz, aber dicht, Augen gross. — 3. Fühlerglied auffallend klein, höchstens ⅓ so lang wie das 4., 4.—11. Glied etwa gleich lang, nach vorn sehr stark an Breite abnehmend, 10. und 11. fast linealwalzig, Behaarung kurz, aber sehr dicht. — Prothorax mit der discoidale Areole am Vorder- und Hinterrand geschlossen, Punktierung überall sehr kräftig, Behaarung kurz und dicht, Schildchen länger als breit, seitlich fast parallel, Hinterrand eingekerbt, kurz behaart, Elytren mit deutlicher Rippen- und Gitterbildung, die von der Behaarung nicht verdeckt wird.

Länge: 10 mm, Breite (hum.): 2½ mm.
G. Tangkoeban Prahoe 4—5000′ Preanger (Drescher) X.28.
1 ♀ Typus in meiner Sammlung.

Die Art ähnelt sehr *confertus* Kln. von den Philippinen, von der sie sich leicht dadurch unterscheidet, dass *confertus* eine gelbe Brust, ebenso gefärbte Schenkel und ein langes 3. Fühlerglied hat.

incarnatus n. sp. (Fig. 4).

Schwarz, Prothorax, Schildchen und Elytren hellrotorange. — Kopfbildung wie bei der vorigen Art, die Vertiefung auf der Stirn ist aber grösser und fast kreisförmig, die Fühlerbeulen sind schmaler und flacher, Punktierung sehr zart, keine nennenswerte Behaarung. — Fühler sehr schlank, 3. Glied wenig kürzer als das 4., 4.—11. gleich lang, nach vorn zu schmaler werdend, 10. und 11. Glied linear, Punktierung tief und klein, Behaarung kurz. — Prothorax breiter als lang, discoidale Areole am Hinter- und Vorderrand auffällig breit bleibend, Skulptur kräftig, aber durch die Behaarung stark verdeckt. — Schildchen wie bei der vorigen Art, Elytren mit sehr deutlicher Rippen- und Gitterbildung, Gitterung vorherrschend quadratisch bis quer rechteckig.

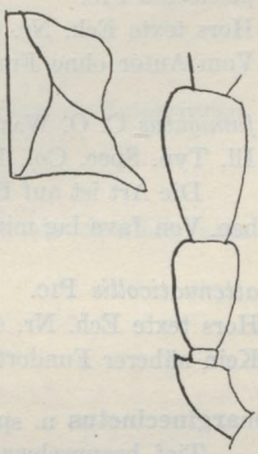

Fig. 4. *Prothapes incarnatus*, n. sp. Prothorax und 1.—4. Fühlerglied.

Länge: 7½—11 mm, Breite (hum.): 2—2½ mm.
G. Tangkoeban Prahoe 4—5000′ Preanger (Drescher) X.28., VI.29.
3 ♀♀ Typus in meiner Sammlung.

Die Art steht dem allerdings viel kleineren *miniatus* aus Perak am nächsten, unterscheidet sich aber sehr leicht durch die Fühler, die bei jener Art vom 4. — 10. Glied fast gleich breit und lang behaart sind, ausserdem ist die Brust gelb, die Schenkel sind an der Basis hell, auch der Prothorax hat eine andere Form.

Uebersicht über die Arten.

Prothorax, Schildchen und Elytren strohgelb, 3. Fühlerglied klein, etwa ⅓ so lang wie das 4., Areole des Prothorax am Vorderrand schmal, geschlossen *drescheri* n. sp.

Prothorax, Schildchen und Elytren hellorange, 3. Fühlerglied nur wenig kürzer als das 4., Areole des Prothorax am Vorderrand breit, offen . . . *incarnatus* n. sp.

Cladophorinae.

Xylobanus C. O. Waterhouse.

Ill. Typ. Spec. Col. Lycid. I, 1879, p.38.

frater Bourgeois.
Ann. Mus. Civ. Stor. Nat. Gen.XVIII, 1883, p. 642.

Der Autor beschrieb die Art von Tjibodas, 1400 m, von BECCARI gesammelt. Mir lagen aus DRESCHERS Ausbeute folgende Fundorte vor: G. Tangkoeban Prahoe 4—5000′ Preanger; G. Patoeha, Preanger 5000′. Die Art ist nicht selten.

piceithorax PIC.
Hors texte Ech. Nr. 407, 1922, p. 15.

Der Autor beschreibt die Art von Sumatra, ich sah sie auch von dort. Sie scheint in Sumatra ihr Hauptgebiet zu haben. Von Java lagen mir einige Stücke ohne Fundort vor, ferner Depok, zwischen Batavia und Buitenzorg (KARNY).

piceicollis PIC.
Hors texte Ech. Nr. 407, 1922, p. 16.
Vom Autor ohne Fundortangabe beschrieben. Ich sah die Art nicht.

fumigatus C. O. WATERHOUSE.
Ill. Typ. Spec. Col. Lycid. I, 1879, p. 42,Taf.XI,Fig.1.

Die Art ist auf Borneo häufig, WATERHOUSE hat sie auch von dort beschrieben. Von Java lag mir nur ein Fundort vor: G. Slamat, Batoerraden (DRESCHER).

attenuaticollis PIC.
Hors texte Ech. Nr. 407, 1922, p. 15.
Kein näherer Fundort angegeben, mir lag die Art nicht vor.

marginecinctus n. sp. (Fig. 5).

Tief braunschwarz, Elytren schmutzig lehmgelb, das hintere Drittel, ein schmaler Aussenrand bis zum Humerus und die Sutura bis über die Mitte schwarz oder braun, glanzmäßig. — Kopf über den Fühlerbeulen breit, flach vertieft, ohne merkliche Skulptur, Fühlerbeulen stärker behaart. — Fühler robust, 3. Glied dreieckig, die folgenden von ähnlicher Gestalt, nach vorn zu schmaler, aber nicht kürzer werdend, die vorderen Glieder daher auch schwächer gezahnt. — Prothorax von der Gestalt eines *Bulenides*, namentlich *indus*, am Vorderrand noch mit deutlichen Areolen, discoidale Areole flach, Ränder aufgebogen, Punktierung am Vorder- und Seitenrand kräftig. — Schildchen lang-dreieckig, hinten flach eingebuchtet. — Elytren mit kräftigen Rippen und deutlicher Gitterung von quadratischer bis quer rechteckiger Form, Behaarung einzeln, kurz.

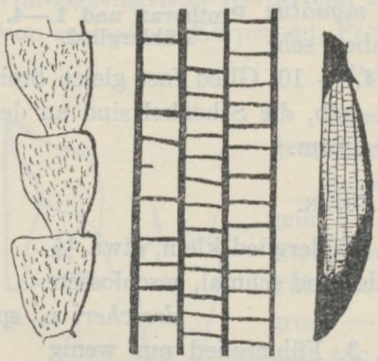

Fig 5. *Xylobanus marginecinctus*, n. sp.
3.—5. Fühlerglied, Elytrengitterung und Farbenverteilung.

Länge: 7 mm, Breite (hum.): 2 mm circa.

W. Java: Preanger, G. Patoeha, 5000′ 19.—25.IX.1926 (F. C. DRESCHER). 1 ♂ ♀. Typus des ♀ im Zoolog. Museum zu Amsterdam, des ♂ in meiner Sammlung.

Die neue Art ist eine Mittelform zwischen *Bulenides* und *Xylobanus*. Der Gestalt nach gehört sie in die erstere Gattung, das Fehlen der Sekundärrippen und die Vorderrandsareolen des Prothorax weisen sie zu *Xylobanus*, wo sie zu Recht steht. Beachtenswert ist die Tatsache, daß die sekundären Rippen durch je ein langes Haar auf der Gitterung angezeigt werden.

Auf jeden Fall ist es eine interessante Art, die die nahe Stellung beider Gattungen dokumentiert.

intricatus C. O. WATERHOUSE.
Ill. Typ. Spec. Col. Lycid. I, 1879, p. 42, Taf. XI, Fig. 3.
Näherer Fundort nicht angegeben; ich sah die Art nicht.

reticulatus GORHAM.
Not. Leyd. Mus. IV, 1882, p. 96.
Einige Belegstücke aus DRESCHERS Ausbeute lagen vor: G. Slamat, Batoerraden.

testaceus PIC.
Hors texte Ech. Nr. 407, 1922, p. 16.
Der Autor gibt keinen näheren Fundort an. Ich sah sie ebenfalls aber leider auch ohne genaue Ortsbezeichnung.

rigidus C. O. WATERHOUSE.
Ill. Typ. Spec. Col. Lycid. I, 1879, p.40,Taf.X,Fig.1,1a.
Nähere Fundortangabe fehlt; ich sah die Art selbst nicht.

fastidiosus C. O. WATERHOUSE.
Ill. Typ. Spec. Col. I, Lycid. 1879, p.39,Taf.X,Fig.3.
Nähere Ortsbezeichnung fehlt. Die Art scheint selten zu sein, ich sah sie auch sonst von einer anderen Insel noch nicht.

dimidiatus GORHAM.
Not. Leyd. Mus. IV, 1882, p. 97.
Preanger 4—6000′ (WARBURG).

horrendus KLEINE.
Treubia IX,Nr.4, 1926,p.308,Taf.VII,Fig.35.55,Taf.VIII,Fig.110.
Preanger (SIJTHOFF).

parviareolatus KLEINE.
Tijdschr.Ent.LXX,1927,p.62,Fig.108.
West-Java: Pengalengan 4000′.

tenggerensis PIC.
Hors texte Ech. Nr. 419, 1925, p. 6.
G. Tengger (AUTOR). Ich sah die Art in dem mir vorgelegenen Material noch nicht.

javanus PIC.
Hors texte Ech. Nr. 407, 1922, p. 16.
Nähere Ortsbezeichnung fehlt; ich sah die Art noch nicht.

pallidior PIC.
Hors texte Ech. Nr. 407, 1922, p. 16.
Wie vor.

elongatus BOURGEOIS.
Ann. Mus. Civ. Stor. Nat. Gen. XVIII, 1883, p. 640.
BOURGEOIS beschrieb die Art von Sinagar (BECCARI). Ich sah, von DRESCHER gesammelt, Stücke von Noesa Kambangan und G. Slamat, Batoerraden.

gratiosus C. O. WATERHOUSE.
Ill. Typ. Spec. Col. Lycid.I,1879, p.39,Taf.IX,Fig.11.
Die Art ist von den Andamanen beschrieben, ich habe sie von daher häufig gesehen, es scheint dort der häufigste *Xylobanus* zu sein. Ich sah Material vom G. Tengger 4000′ von FRUHSTORFER gesammelt. Die Art ist für Java aber mit Fragezeichen zu versehen. Weiteres Material muss Aufklärung bringen. Die zoogeographischen Erfahrungen sprechen gegen ein Vorkommen auf so auseinander liegenden Verbreitungsgebieten. Allerdings muss zugestanden werden, dass die Andamanen faunistisch wenig Anlehnung an Indien, mehr an die Sundainseln haben.

captiosus KLEINE.
Treubia IX,1926,Nr.4,p.303,Taf.VII,Fig.40,43.
G. Papandajan (DRESCHER, FRUHSTORFER); G. Tangkoeban Prahoe 4—5000′ Preanger (DRESCHER).

sublineatus PIC.
Hors texte Ech.Nr.407,1922, p.15
Autor: Java ohne näheren Fundort. DRESCHER fand sie: Noesa Kambangan.

longus PIC.
Hors texte Ech. Nr.407, 1922, p. 15.
Nähere Fundortangabe fehlt; ich sah die Art nicht.

goentoerensis n. sp. (Fig. 6).

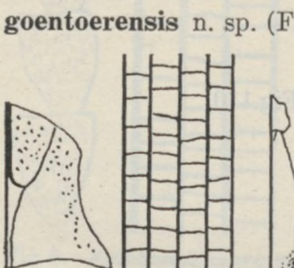

Fig. 6. *Xylobanus goentoerensis*, n. sp. Prothorax, Elytrengitterung und Farbenverteilung.

Schwarz, Kopf hellgelb behaart, Prothorax, Schildchen und Elytren hell strohgelb, letztere nach dem Hinterrande zu schwach verdunkelt. — Stirn breit, über den Fühlerbeulen eingesenkt, Fühlerbeulen kräftig entwickelt mit undeutlicher Mittelfurche, Augen groß. — Fühler schlank, vom 3. Gliede an etwas an Länge zu-, an Breite dagegen abnehmend, schwach gezähnt, kurz, dicht behaart. — Prothorax am Hinterrande so breit wie in der Mitte hoch, Vorderrand schräg abfallend, Vorderecken stumpf aber deutlich, Seiten etwas nach innen geschwungen, Hinterrand fast gerade, 5 Areolen, die alle nur mittelstark entwickelt sind, Punktierung undeutlich. — Schildchen verkehrt herzförmig, hinten fast 3eckig eingekerbt. — Auf den

Elytren sind Rippen und Gitterung recht kräftig entwickelt, letztere von vorherrschend quadratischer Form. Nach dem Hinterrande zu wird die Gitterung mehr quer rechteckig, Rippen und Gitterung kurz behaart, durch die Behaarung glänzend, Elytren grundmatt.

Länge: 9 mm, Breite (hum.): 2 mm circa.

G. Goentoer 15.VIII. 1916. Sammler unbekannt.

Typus ♀ in meinem Besitz.

amandus KLEINE.
Tijdschr. Ent. LXX,1927,p.69,Fig.142,143.
G. Slamat (DRESCHER).

saranganus n. sp.

Tiefschwarz, Prothorax an den Rändern, zuweilen auch an den Areolenrippen gelb, Elytren in der vorderen Hälfte hell lehmgelb, die Schwarzfärbung im hinteren Teil setzt sich am Aussenrand und an der Sutura noch etwas fort. — Kopf breit, Augen klein und flach, über den Fühlerbeulen vertieft. — Fühler schlank, vom 3.—11. Gliede fast gleich lang, das 3. aber deutlich kürzer als das 4., vom 4. Glied ab wenigstens doppelt so breit als lang, Behaarung kurz. — Prothorax schlank, länger als breit, Vorderecken stumpf, gerundet, Seiten nach innen geschwungen, Hinterecken etwas vorgezogen, 5 deutliche, scharfkantige Areolen, Punktierung am Vorderrand gross und tief. — Schildchen verkehrt herzförmig, am Hinterrand tief eingekerbt. — Gitterung auf den Elytren meist quadratisch, seltener lang oder quer rechteckig, scharf vom Grund abgehoben, Behaarung äusserst schwach.

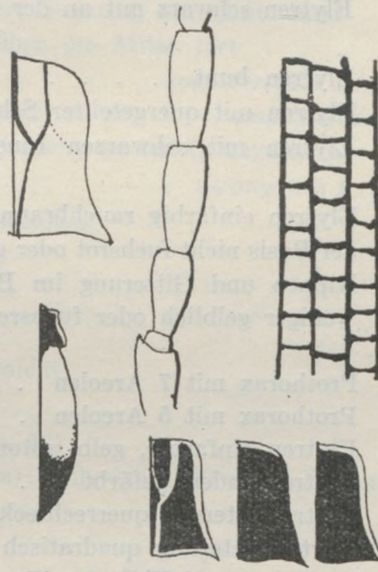

Fig. 7. *Xylobanus saranganus*, n. sp.
Prothorax, 1.—5. Fühlerglied, Elytrengitterung, Farbenverteilung und Farbenvariationen des Prothorax.

Länge: 7 mm, Breite (hum.): 1½ mm circa.

M. Java, Sarangan, bei Madioen, Lawoe Geb. 1500—2000 m, H. OVERBECK.

3 ♂♂ Typus in meiner Sammlung.

Die Art steht *marginecinctus* KLN. am nächsten. Sie unterscheidet sich durch folgende Merkmale: Die Augen sind sehr klein, etwa ¼ so gross wie bei genannter Art, die Fühlerglieder sind nicht kurz und tief gezähnt, sondern lang und ungezähnt, der Prothorax hat 5 deutliche Areolen, während er bei *marginecinctus* nur eine discoidale hat. Die Elytrengitterung vorwiegend quadratisch, niemals quer rechteckig. Ausserdem ist *saranganus* hochglänzend, die Elytrenrippen und die Gitterung sind nicht behaart, bei der anderen Art trifft das umgekehrte zu.

UEBERSICHT ÜBER DIE ARTEN.

1. Prothorax dunkel, schwarz oder braun in verschiedenen Tiefen und Tönungen 2
   Prothorax hellfarbig, gelb, rot, orange oder in ähnlichen Tönungen 7
   Prothorax bunt 21
2. Prothorax mit 7 Areolen 3
   Prothorax mit 5 Areolen 4
   Prothorax mit 3 Areolen 6
3. Elytren im basalen Teil gelb, die schwarze Partie reicht nicht über die Hälfte hinaus . . . . *frater* BOURG.
   Elytren schwarz, Rippen und Gitterung sind bis dicht zum Hinterrand fuchsrot behaart, Behaarung kurz, schwach . . . . . *piceithorax* PIC.
4. Elytren hellfarbig . . . . *piceicollis* PIC.
   Elytren schwarz mit an der Basis rotbehaarten Rippen . . . . . *fumigatus* C. O. WAT.
   Elytren bunt 5
5. Elytren mit quergeteilter Schwarzfärbung . . . . . *attenuaticollis* PIC.
   Elytren mit schwarzen Innen- und Aussenrändern . . . . . . *marginecinctus* n. sp.
6. Elytren einfarbig rauchbraun bis schwarz, Rippen und Gitterung an der Basis nicht fuchsrot oder gelb behaart . . . . *intricatus* C. O. WAT.
   Rippen und Gitterung im Basalteil der Elytren immer mehr oder weniger gelblich oder fuchsrot behaart, Elytrengrund dunkel . . . . *reticulatus* GORH.
7. Prothorax mit 7 Areolen 8
   Prothorax mit 5 Areolen 12
8. Elytren einfarbig, gelb, rotorange oder rötlich 9
   Elytren anders gefärbt 11
9. Elytrengitterung querrechteckig . . . . *testaceus* PIC.
   Elytrengitterung quadratisch oder langrechteckig 10
10. Prothorax und Elytren orangerot, Fühlerglieder kurz gezahnt . . . *rigidus* C. O. WAT.
    Prothorax gelb-erdfarbig, Elytren orangerot, Zähnung der Fühlerglieder kürzer als bei *rigidus* . . *fastidiosus* C. O. WAT.
11. Fühler pectinat . . . . *dimidiatus* GORH.
    Fühler nicht pectinat . . . . *horrendus* KLN.
12. Elytren lehmgelb, rotgelb oder schmutziggelb 13
    Elytren wenigstens am Hinterrande dunkel 18
13. Elytrengitterung quer 14
    Elytrengitterung vorherrschend quadratisch, zuweilen hoch- oder querrechteckig, die Quadratform herrscht aber immer vor 15
14. 3.—10. Fühlerglied quadratisch . . . . *parviareolatus* KLN.
    3.—10. Fühlerglied länger als breit . . . . *tenggerensis* PIC.

15. Mittlere Fühlerglieder länger als breit 16
Mittlere Fühlerglieder von quadratischer Gestalt, gezahnt oder stumpf 17
16. Prothorax vorn stark verengt . . . . *javanus* Pic.
Prothorax vorn nicht verengt, fast quadratisch . . . . *pallidior* Pic.
17. Prothorax quadratisch . . . . *elongatus* Bourg.
Prothorax dreieckig, dachförmig abschüssig, seitlich verengt . . .
gratiosus C. O. Wat.
18. Elytrengitterung quer 19
Elytrengitterung vorwiegend quadratisch 20
19. Elytren am Hinterrand quer dunkel gefärbt . . . . . *captiosus* Kln.
Die Dunkelfärbung findet sich als ein schmaler Saum an den Aussenrändern, die Elytren sind also am Hinterrand nicht quer verdunkelt . . . . *sublineatus* Pic.
20. Hinteres Viertel der Elytren schwarz . . . . *longus* Pic.
Die Dunkelfärbung findet sich als brauner Schatten am Hinterrand und setzt sich auf den Aussenrand bis über die Mitte fort . . . .
goentoerensis n. sp.
21. Fühler des ♂ pectinat, des ♀ tief gezahnt . . . . . . *amandus* Kln.
Fühler in beiden Geschlechtern schlank, nicht pectinat, ungezahnt
saranganus n. sp.

Bulenides C. O. Waterhouse.

Ill. Typ. Spec. Col. I, Lycid. 1879, p. 34.

nigromaculatus Pic.
Hors texte Ech. Nr. 419, 1925, p. 7.
Ohne nähere Fundortangabe; ich sah die Art nicht.

cognatus Bourgeois.
Ann. Mus. Civ. Stor. Nat. Gen. XVIII, 1883, p. 637.
Preanger, Poentjak, G. Megamendoeng (Pasteur); Tjibodas, 1400 m (v.d.Weele).
Die Art ist auch von Borneo bekannt.

pudicus n. sp. (Fig. 8).

Schwarz, Elytren in der vorderen Hälfte elfenbeinweiss, die schwarze Partie nach dem Aussenrande keilförmig nach vorn vorgezogen, Behaarung auf dem Prothorax, an der Areole, zuweilen goldgelb. — Stirn mehrfach so breit wie ein Augenhalbmesser, über den Fühlerbeulen breit, halbelliptisch vertieft. — 4.—10. Fühlerglied tief gezahnt, an den Mittelgliedern ist die Zahnung am tiefsten, Behaarung kurz, dicht. — Prothorax am Hinterrand so breit wie in der Mitte hoch, Vorderecken gerundet, Hinterecken spitz vorgezogen, Areole schmal, aber wenigstens die basale

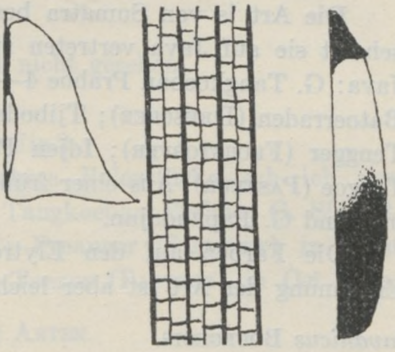

Fig. 8. *Bulenides pudicus*, n. sp. Prothorax, Elytrengitterung, und Farbenverteilung.

Hälfte einnehmend, Seitenränder stark erhöht, Punktierung grob, unscharf. — Schildchen verkehrt herzförmig, flach eingebuchtet, dicht, kurz behaart. — Elytrengitterung von quadratischer bis langrechteckiger Form, Behaarung kurz, dicht.

Länge: 8,5—9 mm, Breite (hum.): 1,5 mm circa.

Toegoe (PASTEUR) aus Coll. ROEPKE.

2 ♀♀ Typus in meiner Sammlung.

Die am nächsten stehende Art ist *cognatus* BOURG., die sich aber schon durch die rote Farbe der Elytrenbasis leicht unterscheidet. Ich sah von *cognatus* eine ganze Anzahl Individuen, die in der roten Färbung der Elytren ebenso constant waren wie *pudicus* in der hellen Farbe. Auch die Art der Elytrengitterung ist in beiden Arten ganz verschieden.

indus KIRSCH.

Mitt. Zool. Mus. Dresden I, 1875, p. 36.

G. Gedeh; G. Slamat, Batoerraden (DRESCHER). Eine weitverbreitete Art. Nur wenige Lyciden haben eine so grosse Migrationsfähigkeit gezeigt. Die Art ist nachgewiesen: Malayische Halbinsel, Sumatra, Borneo. Auf Java ist sie am schwächsten verbreitet. Die starke Variabilität hat zu mehrfachen Beschreibungen Veranlassung gegeben (*brevelineatus* PIC, *vicinus* PIC).

obsoletus C. O. WATERHOUSE.

Trans. Ent. Soc. 1878, p. 100 & 109.

G. Gedeh, Vulkan im Preanger (DRESCHER).

Die Art ist auch von Borneo und Sumatra nachgewiesen.

sijthoffi KLEINE.

Ent. Mitt. XV, Nr.2, 1926,p.149,Fig.3,9,23,28,38.

Preanger (SIJTHOFF); G. Tangkoeban Prahoe 4—5000′; G. Patoea 5000′ Preanger (DRESCHER).

corporaali PIC.

Hors texte Ech. Nr.405,1921,p.8.

Die Art is von Sumatra beschrieben und dort sehr häufig; ebenso stark scheint sie auf Java vertreten zu sein. Mir lagen Belegstücke vor von West Java: G. Tangkoeban Prahoe 4—5000′; G. Patoeha 5000′ Preanger; G. Slamat, Batoerraden (DRESCHER); Tjibodas 1400 m (KARNY). Ferner von Ost Java: G. Tengger (FRUHSTORFER); Idjen Plateau, Ongop-ongop 1850 m (DAMMERMAN); Toegoe (PASTEUR). Aus einer früheren Serie von DRESCHER: Preanger, G. Tjerimai und G. Papandajan.

Die Farben auf den Elytren variieren etwas in der Ausbreitung, die Erkennung der Art ist aber leicht.

javanicus BOURGEOIS.

Ann.Mus.Civ.Stor.Nat.Gen. VVIII,1883,p.639.

Von Tjibodas beschrieben. Ich sah die Art von Toegoe (PASTEUR).

lineatus PIC.
Hors texte Ech. Nr.405, 1921,p.8.
Java ohne nähere Fundortangabe. Ich sah die Art nicht.

UEBERSICHT ÜBER DIE ARTEN.

1. Prothorax schwarz oder wenigstens dunkelbraun 2
   Prothorax gelb, rot oder hellbraun 6
   Prothorax bunt, Areolen und Ränder rot behaart 7
2. Elytren mit gelben oder roten und schwarzen Farbentönen abwechselnd, die Farbenkomplexe sind quer oder schräg geteilt 3
   Elytren schwarz, an der Basis mit mehr oder weniger ausgedehnter roter oder gelber Behaarung der Rippen 5
3. Der rote Basalteil der Elytren mit schwarzem Humerus . . . . *nigromaculatus* PIC.
   Der hell gefärbte Basalteil ist quer durchgehend, kein dunkler Humerus 4
4. Die helle Farbenpartie auf den Elytren ist orangerot *cognatus* C. O. WAT.
   Die helle Farbenpartie auf den Elytren ist elfenbeinweiss . . *pudicus* n. sp.
5. Prothorax schlank, mehr oder weniger langdreieckig . . . *indus* KIRSCH.
   Prothorax halbelliptisch . . . . *obsoletus* C. O. WAT.
6. Orangerot, Prothorax dreieckig mit stark vorgezogenen Hinterecken *sijthoffi* KLN.
   Elytren ziegelrot, Spitzenteil breit, schwarz . . . . . . *corporaali* PIC.
7. Die helle Farbenpartie der Elytren ist ziegelrot . . . *javanicus* BOURG.
   Die helle Farbenpartie der Elytren ist hell erdbraun . . . *lineatus* PIC.

Metanoeus C. O. WATERHOUSE.

Ill.Typ.Spec.Col.I,Lycid.1879 p.73.

dispar C. O. WATERHOUSE.
Trans. Ent. Soc. 1878, p.115.
Weit verbreitete Art, von Malakka, Borneo und Sumatra bekannt.
Mir lag die Art aus Java ohne nähere Fundortangabe aus ROEPKE's Ausbeute vor.

laticollis PIC.
Hors texte Ech.Nr.406,1921,p.11.
Nähere Fundortangabe fehlt. Ich habe die Art nicht gesehen.

fulvus C. O. WATERHOUSE.
Ill.Typ.Spec.Col.I, Lycid.1879 p.74, Taf.XVIII, Fig.2.

Auch diese Art ist weit verbreitet. Sichere Belegstücke sah ich von Penang und Borneo. Fundorte von Java: G. Tangkoeban Prahoe; G. Slamat, Batoerraden; Noesa Kambangan (DRESCHER); Preanger (SIJTHOFF) in West Java, und Idjen Plateau, Kendeng, 1400 m; Toegoe (PASTEUR) in Ost Java.

UEBERSICHT ÜBER DIE ARTEN.

1. Elytren im Spitzenteil mehr oder weniger verdunkelt, schwärzlich oder braun . . . . *dispar* C. O. WAT.

Elytren einfarbig lehmgelb 2

2. Prothorax breiter als lang . . . . *laticollis* PIC.

Prothorax quadratisch . . . . *fulvus* C. O. WAT.

Cladophorus GUÉRIN MÉNÉVILLE.

Voy.Coquille, Ent.p.72.

testaceopunctatus PIC.

Hors texte Ech.Nr.406,1921,p.12.

Nähere Fundortangabe fehlt. Ich sah die Art noch nicht.

nigroapicalis n. sp. (Fig. 9).

Fig. 9 *Cladophorus nigroapicalis*, n. sp. Prothorax und Penis.

Schwarz, Prothorax, Schildchen und Elytren in der vorderen Hälfte lehmgelb. — Stirn flach, breit eingedrückt, Fühlerbeulen wenig entwickelt, Augen groß, prominent, im Halbmesser fast so breit wie die Stirn. — Lamellen der 3.—10. Fühlergliedes etwa 3 mal so lang als das Glied selbst, seitlich stark zusammengedrückt, kurz, robust behaart. — Prothorax mit der discoidale Areole sehr lang und schmal, Punktierung kräftig, aber durch die dichte Behaarung verdeckt. — Schildchen länger als breit, tief eingebuchtet, behaart. — Elytren mit sehr deutlichen Rippen und scharfkantiger Gitterung, Behaarung gering. — Penis siehe die Abbildung.

Länge: 9,5 mm, Breite (hum.): 2,5 mm circa.

Java: Buitenzorg, 24. XI. 90 (WARBURG).

1 ♂ Typus im Hamburger Museum, ♀ nicht gesehen.

Die echten *Cladophorus*-Arten sind im orientalischen Gebiet nicht häufig und ich kenne keine Art, die mit *nigroapicalis* zu vergleichen wäre.

UEBERSICHT ÜBER DIE ARTEN.

1. Elytren einfarbig lehmgelb . . . *testaceopunctatus* PIC.

Elytren mehr oder weniger schwarz 2

2. Elytren ziegelrot, an der Basis in der Länge des Schildchens schwarz *karnyi* n. sp. (s. Seite 291).

Elytren in der basalen Hälfte lehmgelb, Spitzenhälfte schwarz *nigroapicalis* n. sp.

Cautires C. O. WATERHOUSE.

Ill.Typ.Spec.Col.Lycid.I,1879,p.36.

obsoletus KLEINE.

Arch.Nat.XCII,1926,A.12,p.125.

G. Goentoer; G. Slamat (DRESCHER).

javanicus KLEINE.

Treubia IX,Nr.4,1926,p.302,Taf.VI,Fig.29, Taf.VIII,Fig.102.

Preanger (SIJTHOFF); Tengger Geb., Kendeng Geb., Ostjava; G. Tangkoeban Prahoe 4—5000′ (DRESCHER); Pengalengan 4000′.

guttatus n. sp. (Fig. 10).

Schwarz, Prothorax, Schildchen und Elytren ziegelrot bis orange, am Hinterrand in geringem Umfange verdunkelt. — Stirn vertieft, Fühlerbeulen kräftig, länger als breit. — Mittlere Fühlerglieder des ♂ mit Lamellen, die etwas länger als der Stiel sind, Skulptur kräftig, Behaarung sehr dicht. — Areolen des Prothorax mit Ausnahme der seitlichen kräftig entwickelt, Punktierung unter der dichten kurzen Behaarung verborgen. — Schildchen verkehrt herzförmig, halbkreisförmig eingekerbt. — Rippen- und Gitterbildung auf den Elytren sehr deutlich, Gitterfiguren quadratisch bis lang rechteckig, selten von anderer Gestalt.

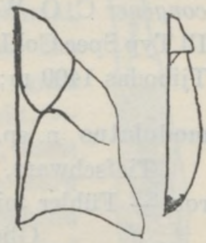

Fig. 10. *Cautires guttatus*, n. sp. Prothorax und Farbenverteilung.

Länge: 12—17 mm, Breite (hum.): 3½—4 mm.

G. Tangkoeban Prahoe 4—5000′ Preanger (DRESCHER).

IX. 29. Preanger (SIJTHOFF).

Die Art sieht dem *grandis* KLN. sehr ähnlich. Sie unterscheidet sich aber sehr leicht durch die gänzlich andere Färbung. Das Exemplar von Preanger ist seit Jahren in meinem Besitz, eine Beschreibung hatte ich unterlassen, weil es sich möglicherweise um eine Variante dieser Art handeln konnte. Nachdem jetzt ein männliches Tier vorliegt, ist die Sicherheit der Art gewährleistet.

1 ♂, 1 ♀ Typen in meiner Sammlung.

drescheri n. sp. (Fig. 11).

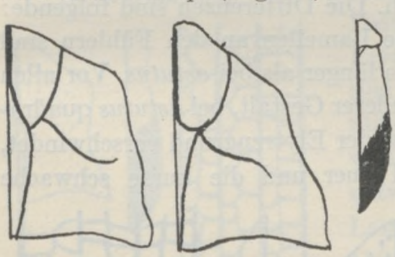

Fig. 11. *Cautires drescheri*, n. sp. Prothoraxformen und Farbenverteilung.

Ausfärbung wie bei der vorigen Art, die Schwarzfärbung auf den Elytren nimmt aber fast die hintere Hälfte ein, sie ist von keilförmiger Gestalt und verläuft am Seitenrand am weitesten nach vorn. — Kopf wie bei der vorigen Art. — Lamellen der mittleren Fühlerglieder beim ♂ etwa 4 mal so lang als das Glied selbst, beim ♀ 1½ mal so lang. — Prothorax von etwas wechselnder Gestalt, siehe die Abb., nur die in den Vorderrand verlaufenden Areolen sind kräftig entwickelt, Punktierung unter der Behaarung verborgen. — Schildchen verkehrt herzförmig, hinten 3-eckig eingekerbt. — Elytren mit deutlicher Rippenbildung, Gitterung weniger scharf, vorherrschend quadratisch, quer rechteckig.

Länge: 11 mm, Breite (hum.): 3 mm.

G. Patoeha 7000′ Preanger 14. XI. 28.

G. Slamat, Batoerraden I.27., V.27., VI.27., X.27., IV.28., VII.28.

1 ♂, 6 ♀ ♀ Typen in meiner Sammlung.

Die nächststehende Art ist *pulcher* KLN. von Java. Hauptunterschiede sind: *pulcher* ist kleiner, die Fühlerlamellen sind kürzer. Die Anordnung der schwarzen Farben auf den Elytren ist eine andere.

congener C. O. WATERHOUSE.
Ill.Typ.Spec.Col.Lycid.I,1879,p.36 Taf.IX,Fig.7.
Tjibodas 1400 m; Idjen Plateau (Mus. Buitenzorg).

modulatus n. sp. (Fig. 12).

Tiefschwarz, Prothorax, Schildchen und Elytren in den vorderen ⅔ ziegelrot. — Fühler mit langen Lamellen, 3. Glied Lamelle dreimal so lang als das Glied selbst, am 4. und 5. sind die Lamellen 4 mal so lang als das Glied, nach vorn werden die Glieder länger, am 10. ist die Lamelle nur noch 2½ mal so lang als das Glied. Alle Lamellen schmal, dicht behaart. — Prothorax breiter als lang, Vorderrand wellig abfallend, Vorderecken stumpf, Seiten gerade, etwas aufgebogen, Hinterrand geschwungen, Hinterecken nicht vorgezogen, gerade, Areolen unscharf, die seitlichen kaum angedeutet, nur der Kiel der discoidalen schärfer, Randpunktierung durch die Behaarung ganz verdeckt. — Schildchen verkehrt herzförmig, am Hinterrand tief halb elliptisch eingekerbt, dicht behaart. — Elytren mit vorherrschend querer Gitterung, die nicht durch Behaarung verdeckt ist.

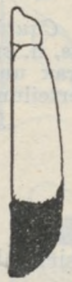

Fig. 12. *Cautires modulatus*, **n. sp. Farbenverteilung.**

Länge: 13 mm, Breite (hum.): 3 mm.

W. Java: G. Boender, Salak 1200 m 25. XII.29. (M. A. LIEFTINCK).

1 ♂. Typus in Museum Buitenzorg.

Modulatus sieht *astutus* WALK. sehr ähnlich. Die Differenzen sind folgende: Die Färbung ist ziegelrot, nicht rot orange, die Lamellen an den Fühlern sind zum Teil 4 mal so lang wie das Glied selbst, also länger als bei *astutus*. Vor allen Dingen ist die Elytrengitterung aber von ganz anderer Gestalt, bei *astutus* quadratisch und durch Behaarung ganz verdeckt, sodass der Elytrengrund verschwindet, bei *modulatus* ist sie hingegen vorherrschend quer und die kurze schwache Behaarung verdeckt weder die Gitterung noch den Elytrengrund.

roepkei n. sp. (Fig. 13—14).

Schwarz, Prothorax, Schildchen und die Elytren in den vorderen zwei Dritteln hell strohgelb, am ganzen Körper mäßig glänzend. — Stirn schräg abfallend, nur ganz schwach vertieft., Fühlerbeulen wenig entwickelt mit schwacher Mit-

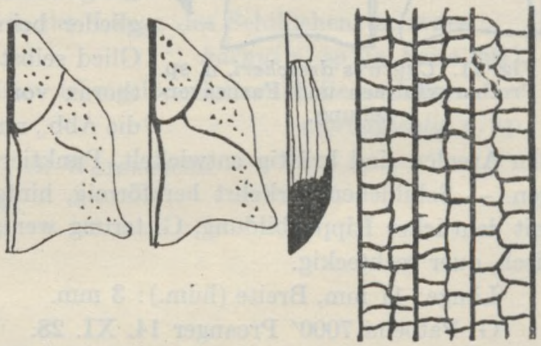

Fig. 13. *Cautires roepkei*, **n. sp. Prothoraxformen, Farbenverteilung und Elytrengitterung.**

telfurche, Augen sehr prominent, Lamellen der mittleren Fühlerglieder 4 mal so lang als das Glied selbst, schmal, zungenförmig, Behaarung kurz und dicht. — Prothorax breiter als lang, Vorderrand dachförmig abfallend, ohne Ecken in den Seitenrand übergehend, Hinterrand in der Mitte vorgezogen, Seitenränder stark aufgebogen, discoidale Areole schmal, der davor liegende Kiel auffallend stark entwickelt, die in den Vorderrand verlaufenden Areolen schwach, die seitlichen ganz obsolet, die Punktierung durch die dichte Behaarung verdeckt. — Schildchen fast parallel, hinten fast kreisförmig eingebuchtet, dicht und kurz behaart. — Auf den Elytren sind die Primärrippen stark entwickelt, die sekundären sind undeutlich, Gitterung vorherrschend quadratisch bis quer rechteckig, an den Seiten 5eckig, zuweilen sind die Figuren, namentlich im Basalteil, recht undeutlich.

Länge: 12,5 mm, Breite (hum.): 3 mm.

G. Telomojo ca. 1500 m IX.1916 von Professor ROEPKE gesammelt, dem ich diese schöne Art widme.

Typen ♂ ♀ in meiner Sammlung.

Fig. 14. *Cautires roepkei,* n. sp. Penis.

grandissimus KLEINE.

Arch.Nat.LXXXXII, A.12,1926, p.127, Taf.2, Fig.40,41.

Tjibodas 1400 m; Preanger (SIJTHOFF); *G. Goentoer* (DRESCHER).

pulcher KLEINE.

Arch.Nat.LXXXXII, A.12,1926, p.128, Taf.II, Fig.42—45.

G. Slamat; G. Goentoer (DRESCHER).

salatiganus n. sp. (Fig. 15—16).

Schwarzbraun, Stirn gelbbraun, Prothorax, Schildchen und das vordere Drittel der Elytren orangerot, auf den Elytren gehen die beiden Farbenpartien allmählich ineinander über. — Stirn über den Fühlerbeulen stark vertieft, Fühlerbeulen selbst kräftig entwickelt, Augen prominent. — Lamellen der mittleren Fühlerglieder 1½—2 mal so lang wie das Glied selbst, kurz und dicht behaart. — Prothorax quadratisch, Vorderrand dachförmig schräg abfallend, Vorderecken stumpf, aber deutlich, Seiten etwas nach innen gebogen, erhöht, Hinterrand wenig geschwungen, discoidale Areole sehr schmal, bis zur Hälfte reichend, der davor liegende Kiel stark ausgebildet, die in den Vorderrand verlaufenden Areolen sowohl an der discoidalen Areole wie am Rand selbst unterbrochen, seitliche Areolen fehlen gänzlich, Punktierung kräftig, deutlich. — Schild-

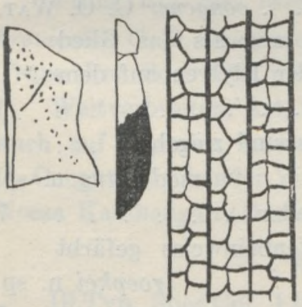

Fig 15. *Cautires salatiganus* n. sp. Prothorax, Farbenverteilung und Elytrengitterung.

Fig. 16. *Cautires salatiganus,* n. sp. Penis.

chen viel länger als breit, am Hinterrand schwach eingebuchtet. — Elytren mit sehr deutlichen Primär- und Sekundärrippen, auch die Gitterung ist kräftig entwickelt, ihre Form ist wechselnd, quadratisch bis 5eckig. — Penis sehr hyalin.

Länge: 8 mm, Breite (hum.): 1,75 mm.

Salatiga XI 1917. Sammler: W. ROEPKE.

Type ♂ in meinem Besitz.

UEBERSICHT ÜBER DIE ARTEN.

1. Elytren rotgelb, gelb oder rot 2
   Elytren bunt . . . . , 3
2. Augen sehr gross, weit über den Prothorax hervorragend. . *obsoletus* KLN.
   Augen klein, unter dem Prothorax verborgen . . . . . *javanicus* KLN.
3. Die seitlichen Areolen sind auf dem Prothorax zwar vorhanden, erreichen aber den Aussenrand nicht und sind nur mit der discoidalen Areolen verbunden 4
   Die seitlichen Areolen sind nur angedeutet und ganz rudimentär . . . 5
4. Elytren am Hinterrand nur in ganz geringem Umfange verdunkelt, Lamellen der männlichen Fühlerglieder nur wenig länger als das Glied selbst . . . . *guttatus* n. sp.
   Die ganze hintere Hälfte der Elytren ist schwarz, Lamellen der männlichen Fühlerglieder viermal so lang als das Glied selbst . . *drescheri* n. sp.
5. Mittlere Fühlerglieder des Mannes nur so lang wie das Glied selbst oder kürzer, Gitterungsgrund auf den Elytren auch im hellen Teil dunkel . . . . *congener* C. O. WAT.
   Mittlere Fühlerglieder des Mannes 2½ mal so lang als das Glied selbst, meist aber noch länger, Gitterungsgrund der Elytren auf dem hellen Teil der Elytren hell 6
6. Die hellen Partien auf der Oberseite des Körpers sind ziegelrot . . *modulatus* n. sp.
   Die hellen Partien sind orange, gelb oder noch heller 7
7. Die hellen Körperteile sind strohgelb, fast elfenbeinweiss gefärbt *roepkei* n. sp.
   Die hellen Körperteile sind orangerot 8
8. Grosse Art, ca. 18 mm lang, Prothorax quer . . . *grandissimus* KLN.
   Kleine Arten 8—10 mm lang, Prothorax quadratisch oder höher als breit 9
9. Lamellen der mittleren Fühlerglieder beim Mann 3—4 mal so lang als das Glied selbst, auf dem Prothorax sind die in den Vorderrand mündenden Areolen scharfkantig und voll entwickelt . . . *pulcher* KLN.
   Lamellen der mittleren Fühlerglieder beim Mann 1½—2 mal so lang als das Glied selbst, nur die discoidale Areole ist entwickelt, die in den Vorderrand mündenden sind ganz rudimentär . . . *salatiganus* n. sp.

Procautires Kleine.

Treubia VII,Nr.1,1925,p.32.

slamatensis n. sp. (Fig. 17).

Schwarz, Prothorax, Schildchen und Elytren fast bis zur Hälfte zinnoberrot. — Stirn von Auge zu Auge vertieft, Fühlerbeulen schmal, aber deutlich erhöht, Lamellen vom 3.—10. Glied fast gleich lang, etwa 3 mal so lang wie der Stiel, parallel, schmal, Skulptur kräftig, Behaarung kurz. — Prothorax mit 7 deutlichen Areolen, Punktierung unscharf, Behaarung kurz. — Schildchen gross, länger als breit, parallel, am Hinterrand kräftig eingebuchtet, kurz behaart. — Elytren in der Mitte verengt, im Basalteil mit deutlichen Sekundärrippen, Gitterung an der Basis vorherrschend quadratisch, nach der Mitte zu werden die Figuren 5 eckig und schliesslich verschwinden die Sekundärrippen gänzlich, treten auch in der Hinterrandspartie nicht wieder auf.

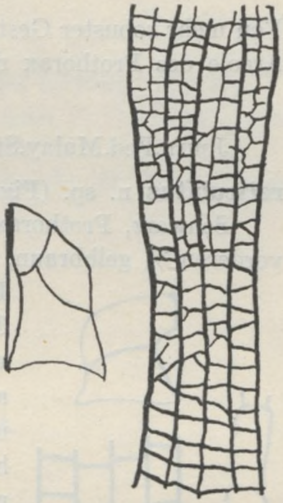

Fig. 17. *Procautires slamatensis*, n. sp. Prothorax und Elytrengitterung.

Länge: 8 mm, Breite (hum.): 2 mm.

G. Slamat, Batoerraden I.28. (Drescher).

1 ♂ Typus in meiner Sammlung.

Mit keiner anderen Art zu verwechseln, da die Sekundärrippen auch in der Hinterrandspartie nicht wieder auftreten, was bei allen anderen Arten der Fall ist.

Taphes C. O. Waterhouse.

Trans. Ent. Soc. 1878, p. 102.

brevicollis C. O. Waterhouse.

Trans. Ent. Soc. 1778, p. 110.

Weitverbreitete Art, ich sah Belegstücke von Singapore und Borneo, sicher auch auf Sumatra vorhanden. Von Java lagen mir folgende Fundorte vor: G. Oengaran, ruhender Vulkan an der Nordküste oberhalb Semarang; Tjilatjap; Noesa Kambangan (Drescher).

Conderis C. O. Waterhouse.

Ill.Typ. Spec.Col. I,Lycid.1879,p.59.

signicollis Kirsch.

Mitt. Zool. Mus. Dresden I, 1875, p. 36.

Weit verbreitete, sehr variable und gemeine Art. Ich sah zahlreiches Material von Malakka und Sumatra. Von Java lagen mir Belegstücke aus nachstehenden Fundorten vor: West Java: Ins. Noesa Kambangan; Bantam, Urwald; S. Preanger, Patimoean; Koebangkangkoeng, Res. Banjoemas (Drescher). Ost Java: G. Oengaran, ruhender Vulkan an der Nordküste Javas oberhalb Semarang.

parallelus PIC.
Hors texte Ech. Nr. 405, 1921, p. 7.
Nähere Fundortangabe fehlt. Ich habe die Art nicht gesehen.

UEBERSICHT ÜBER DIE ARTEN.

Schlanke, parallele Art, discoidale Areole des Prothorax lang und schmal *parallelus* PIC.
Von mehr robuster Gestalt, Elytren nach hinten etwas erweitert, discoidale Areole des Prothorax rhombisch, breit . . . . *signicollis* KIRSCH.

Xylobanellus KLEINE.

Journ.Fed.Malay.Stat.Mus.(im Druck).

reticulatus n. sp. (Fig. 18).

Schwarz, Prothorax an den Rändern zum Teil gelbbraun, Elytren in den vorderen ⅔ gelbbraun, am ganzen Körper glänzend. — Stirn ohne Einsenkung, Fühlerbeulen rudimentär, ohne Skulptur, Fühler schlank, 3.—10. Glied etwa gleich lang, das 3. am kürzesten, 11. wenig länger als das 10., nach vorn nehmen die Glieder an Breite ab und werden mehr walzig, Behaarung kurz und dicht. — Prothorax breiter als lang, discoidale Areole hinten geschlossen, Skulptur sehr schwach, Behaarung nur auf den Rändern und auch da schwach. — Schildchen länger als breit, verkehrt herzförmig, am Hinterrand schwach eingekerbt, undeutlich behaart. — Elytren mit sehr deutlichen Rippen und gleich starker Gitterung, letztere vorwiegend lang rechteckig, seltener quadratisch, Gitterungsgrund unbehaart, Rippen und Gitterung mit kurzer Behaarung.

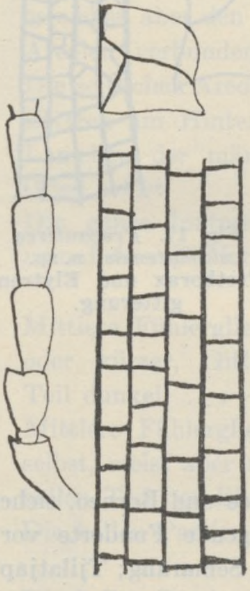

Fig. 18. *Xylobanellus reticulatus*, n. sp. 1.—6. Fühlerglied, Prothorax und Elytrengitterung.

Länge: 6½ mm, Breite (hum.): 1½ mm circa.

G. Tangkoeban Prahoe 4—5000′ Preanger X.29. (DRESCHER).

1 ♀ Typus in meiner Sammlung.

Von den bekannten *Xylobanellus*-Arten unterscheidet sich *reticulatus* leicht durch die zweifarbigen Flügeldecken. Alle bisher bekannten Arten sind einfarbig. Es ist interessant, dass die Gattung auch auf Java vorkommt und beweist, dass die Verbreitung eine recht weite ist. Die Gattungscharaktere haben durch die neue Art, die mit den anderen genau übereinstimmt, eine wichtige Bestätigung gefunden.

Atelinae.

Scarelus C. O. WATERHOUSE.

Trans.Ent.Soc.,1878,p.104.

longicornis C. O. WATERHOUSE.
Trans.Ent.Soc.,1878,p.116.

Bisher nur von Java bekannt, der Autor gibt keinen näheren Fundort an. Ich sah das Tier von G. Patoeha 5000′ Preanger (DRESCHER).

orbatus C. O. WATERHOUSE.
Trans.Ent.Soc.,1878,p.117.

Der Autor beschrieb die Art von Singapore, ich sah sie von Java mehrfach. Preanger (SIJTHOFF); G. Slamat, Batoerraden (DRESCHER).

UEBERSICHT ÜBER DIE ARTEN.

Elytren lehmgelb, nur unmittelbar am Hinterrand schmal schwarz gefleckt *longicornis* C. O. WATERHOUSE.
Elytren erdgrau, nur an der Basis schmutzig lehmgelb . . . . . . *orbatus* C. O. WATERHOUSE.

Trichalinae.

Trichalus C. O. WATERHOUSE.

Trans.Ent.Soc.1877,p.82.

sulcaticeps PIC.
Hors texte Ech. Nr.406,1921,p.10.
Nähere Fundortbezeichnung fehlt, ich sah die Art nicht.

atricollis PIC.
Hors texte Ech. Nr.406,1921,p.10.
Wie bei der vorigen Art.

testaceicoxis PIC.
Hors texte Ech. Nr.406,1921,p.10.
Desgleichen.

niger C. O. WATERHOUSE.
Ill. Typ. Spec. Col. I, Lycid. 1879,p.71,Taf.XVII,Fig.8.

Der Umfang dieser Art ist schwer zu fassen, da grosse Aehnlichkeit mit *ater* M. LEAY besteht und die Grenzen beider Arten nicht sicher zu fassen sind. Auf den Sundainseln ist *niger*, wenn auch nicht überall, gleich stark in der Verbreitung. Sie kommt auch auf Celebes vor. WALLACE gibt sie von den Bandainseln an, wo auch *ater* vorkommt. Die ganzen Verhältnisse sind also etwas unklar. Auf den Molukken kommt *niger* sicher vor. Es ist also wohl möglich, dass sich beide Arten auf den Bandainseln treffen. Von Java sah ich sie nicht gerade häufig, so: Buitenzorg (VAN HEURN, ROEPKE).

concolor KLEINE.
Treubia IX,Nr.4,1926,p.312.
Djeroeklegi, Süd Banjoemas; Noesa Kambangan (DRESCHER).

communis C. O. WATERHOUSE.
Ill.Typ.Spec.Col.I,Lycid.1879,p.71,Taf.XVII,Fig.9.

Häufige Art. Von Malakka, Sumatra und anliegenden kleinen Inseln, so Krakatau, Verlaten Eiland etc. bekannt. Von Java sah ich folgende Belegstücke:

Süd Preanger, Patimoean; G. Patoeha 5000′; Djeroeklegi, Süd Banjoemas (DRESCHER); Batavia (GRABOWSKY) Buitenzorg (VAN HEURN).

discretus BOURGEOIS.
Ann.Soc.Ent.Fr.(6)III,1884,p.67.
Mir nur von Java bekannt. Die Art scheint selten zu sein, ich sah nur einen Beleg: G. Slamat (DRESCHER).

curticollis PIC.
Hors texte Ech. Nr.428,1927,p.42.

javanus PIC.
l.c.p.42.

Beide Arten sind ohne näheren Fundort und von mir in dem untersuchten Material bisher nicht aufgefunden.

UEBERSICHT ÜBER DIE ARTEN.

1.	Prothorax schwarz, grauschwarz oder braun	2
	Prothorax gelb oder orange	5
	Prothorax bunt	*sulcaticeps* PIC.
2.	Elytren im Basalteil orange, Spitzenteil schwarz	*atricollis* PIC.
	Elytren einfarbig schwarz, grauschwarz oder schwarzbraun	3
3.	Prothorax hinter der Mitte seitlich zahnartig vorgezogen, Hüften aller Beine hell	*testaceicoxis* PIC.
	Prothorax nicht vorgezogen, Hüften nicht heller	4
4.	Seiten des Prothorax stark nach aussen gerundet, Hinterecken nicht spitz vorgezogen, Areole breit, Grundfarbe schwarz . .	*niger* C. O. WAT.
	Seiten des Prothorax hinter der Mitte mit kräftiger, zahnartiger Erweiterung, Hinterecken spitz, Areole schmal, Grundfarbe graubraun	*concolor* KLN.
5.	Schildchen schwarz	6
	Schildchen gelb oder bräunlich	7
6.	Hüften gelb, Schenkelbasis zuweilen von gleicher Farbe, Prothorax trapezoid	*communis* C. O. WAT.
	Die ganzen Beine dunkel, Prothorax quadratisch . . .	*discretus* BOURG.
7.	Prothorax breiter als lang	*curticollis* PIC.
	Prothorax quadratisch, oder höher als breit	*javanus* PIC.

Leptotrichalus KLEINE.

Philipp. Journ. Sc. XXVIII,Nr.2,1925,p.296.

cyaniventris KIRSCH.
Mitt. Zool. Mus. Dresden I, 1875, p. 35.

Eine der weitverbreiteten Lycidenarten, dazu häufig und etwas variabel, namentlich in der Farbe der Rippen. Daher auch verschiedene Beschreibungen. Bei grossem Material ist die Variationsbreite erst zu erkennen. Ich sah Belege

von Malakka, Sumatra, Mentawei, Borneo. Auch auf Java ist die Art keineswegs selten und kommt von einem Fundort meist in grossen Serien. Mir lagen folgende Fundorte vor: W. Selabintana, bei Soekaboemi, Preanger (BRYANT); G. Slamat (DRESCHER).

javanus KLEINE.
Treubia IX,Nr.4,1926,p.313.

Bisher sah ich die Art nur von ein und demselben Fundort, aber von ganz verschiedenen Sammlern: Tjibodas 1500 m Seehöhe.

pullus KLEINE.
Treubia IX,Nr.4,1926,p.313.
G. Tangkoeban Prahoe 4—5000′; G. Patoeha 5000′ Preanger (DRESCHER).

atricollis PIC.
Hors texte Ech. Nr.428,1927,p.41.
Nähere Fundortangabe fehlt; ich sah die Art noch nicht.

conciliatus KLEINE.
Philipp. Journ. Sc. XXVIII,Nr.2,1925,p.299,Taf.I.Fig.3.
G. Tjerimai, Vulkan an der Nordküste, (DRESCHER); Tonsea lama (Buitenzorg). Ausserdem sah ich Material ohne nähere Fundortangabe.

inapicalis PIC.
Hors texte Ech. Nr.428,1927,p.41.
Kein näherer Fundort bekannt; ich sah die Art nicht.

rufobasalis PIC.
Hors texte Ech. Nr.428.1927,p.41.
Wie bei der vorigen Art.

concinnus KLEINE.
Philipp. Journ. Sc. XXVIII, Nr.2, 1925, p.306.
G. Papandajan, Vulkan im Preanger, West-Java (DRESCHER).

submarginatus PIC.
Hors texte Ech. Nr.406,1921,p.10.
Kein näherer Fundort, ich sah die Art noch nicht.

tosarianus n. sp.

Dunkelbraun, hell behaart, Prothorax an den Seitenrändern lehmgelb, Elytren von gleicher Farbe, am Hinterrand in etwa $^1/_7$ der Länge schwarzbraun. — Gitterung auf den Elytren wechselnd, langrechteckig, quadratisch oder querrechteckig.

Länge: 10 mm, Breite (hum.): 2 mm.

Tosari, G. Tengger, Ost Java VI.10. Sammler: W. ROEPKE.

Typus ♂, in meiner Sammlung.

Die Art ist mit *submarginatus* PIC zu vergleichen, von der sie sich durch die zweifarbigen Elytren leicht und sicher unterscheidet.

UEBERSICHT ÜBER DIE ARTEN.

1. Prothorax schwarz oder dunkelbraun 2
Prothorax rot, orange oder gelb in verschiedenen Abstufungen . . . 5
Prothorax bunt 8
2. Elytren ganz schwarz . . . . *cyaniventris* KIRSCH.
Elytren anders gefärbt 3
3. Basale Hälfte der Elytren ziegelrot . . . . *javanus* KLN.
Die helle Farbe der Elytren ist gelb oder orange 4
4. Die Schwarzfärbung der Elytren liegt nur am Hinterrande, greift aber auf Sutura und Aussenrand über . . . . *pullus* KLN.
Die Schwarzfärbung reicht bis zur Hälfte . . . . *atricollis* PIC.
5. Elytren einfarbig 6
Elytren bunt 7
6. Abdomen, Brust und Beine schwarz . . . . *conciliatus* KLN.
Hüften und Schenkelbasis lehmgelb, Abdomen schwarzblau *inapicalis* PIC.
7. Die hellen Körperteile sind lehmgelb . . . . *rufobasalis* PIC.
Die hellen Körperteile sind ziegelrot . . . . *concinnus* KLN.
8. Elytren einfarbig . . . . *submarginatus* PIC.
Elytren am Hinterrand schwarzbraun . . . . *tosarianus* n. sp.

Metriorrhynchinae.

Metriorrhynchus GUÉRIN MÉNÉVILLE.

Voy. Coquille 1838, Entom. p. 72.

inaequalis FABR.
Syst. El. II, p. 112.

Von Sumatra liegt die Art öfter vor, von Java sah ich sie bisher nur von Süd Java, Noesa Kambangan (DRESCHER).

sericeus C. O. WATERHOUSE.
Ill. Typ. Spec.Col.I,Lycid. 1878, p.52,Taf.XIII,Fig.5.

Der Autor meldet die Art von Java ohne nähere Fundortangabe, ich habe die Art merkwürdigerweise unter dem zahlreichen, mir vorgelegenen Material niemals gesehen.

cribripennis C. O. WATERHOUSE.
Ill. Typ. Col.I,Lycid. 1878, p.52,Taf.XIII,Fig.6.

Eine weitverbreitete Art. Sie ist eine von den wenigen, die auf den Molukken und Java vorkommt. Wahrscheinlich ist die Art im Verbreitungsmassiv (Australien), gekommen. Die ganze Ausfärbung spricht auch dafür. Man muss annehmen dass auf Java die Westgrenze erreicht ist. Von den Molukken sah ich folgende Fundnotizen: Ternate, Batjan, Halmaheira. Auf Java ist die Art garnicht selten, mir lagen folgende Fundorte vor: G. Tengger 4000′ (FRUHSTORFER) und Idjen Plateau (Mus. Buitenzorg) in Ost Java; Ins. Noesa Kambangan (DRESCHER) in West Java.

luteus GORHAM.
Not.Leyd.Mus. IV,1882,p.95.
Die Art ist von Sumatra beschrieben. Ich sah ein sicheres Stück von Java: G. Slamat (DRESCHER).

UEBERSICHT ÜBER DIE ARTEN.

1. Elytren zweifarbig, basale Hälfte ziegelrot bis schmutzigrot, Spitzenhälfte schwarz . . . . *inaequalis* FABR.
Elytren einfarbig 2
2. Abdomen blauschwarz, metallisch glänzend . . . . . . *sericeus* C. O. WAT.
Abdomen wie die anderen braunen Körperteile braunschwarz gefärbt 3
3. Grosse Art. 18—20 mm, Prothorax länger als breit, alle Fühlerglieder vom 3. ab viel länger als breit, Elytrengitterung schmal, querrechteckig *cribripennis* C. O. WAT.
Kleine Art, 8—10 mm, Prothorax quadratisch, Fühlerglieder gedrungen, kaum länger als breit, schwach gezahnt, Elytrengitterung quadratisch bis fünfeckig . . . . *luteus* GORH.

Platerodinae.

Dihammatus C. O. WATERHOUSE.

Ill. Typ. Spec. Col. I, Lycid. 1879, p. 29.

cribripennis C. O. WATERHOUSE.
Ill.Typ.Spec.Col.I,Lycid.1879,p.29.Taf.VII,Fig.6.
Der Autor gibt keinen näheren Fundort an, ich sah die Art von Noesa Kambangan (DRESCHER).

beccarii BOURGEOIS.
Ann. Mus. Civ. Stor. Nat. Gen. XVIII,1883,p.634.
G. Slamat, Batoerraden; G. Goentoer; Noesa Kambangan; G. Patoeha 5000′, Preanger (DRESCHER); Tjibodas, 1400 m (BECCARI).

pilosus n. sp. (Fig. 19).
Schwarz, Elytren in den vorderen ⅔ lehmgelb, am ganzen Körper glänzend, Stirn 3 mal so breit wie ein Augenhalbmesser, tief halbkreisförmig eingedrückt, Fühlerbeulen kräftig. — Fühler gedrungen, 4.—10. Glied etwa gleich lang, 11. verlängert, platt gedrückt, ungezähnt, kurz, dicht behaart. — Prothorax viel breiter als hoch mit deutlicher Mittelfurche, Seitenränder aufgebogen, Randpunktierung gross, an den Rändern kräftig behaart. — Schildchen tief eingekerbt, nach hinten in 2 zapfenförmige Verlängerungen auslaufend, einzeln behaart. — Elytren sehr dicht und kurz behaart, Rippen und Gitterung verdeckend. —

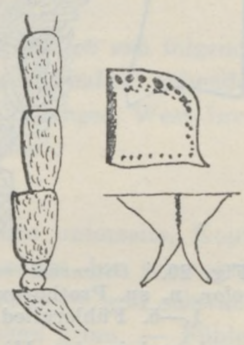

Fig. 19. ***Dihammatus pilosus*, n. sp. 1.—6. Fühlerglied, Prothorax und Schildchen.**

Länge: 6 mm, Breite (hum.): 1,25 mm circa.
G. Patoeha 5000′ Preanger (DRESCHER) V.28.
1 ♂ Typus in meiner Sammlung.

UEBERSICHT ÜBER DIE ARTEN.

1. Prothorax gelbbraun, wie die Elytren, diese in der Spitzenhälfte dunkelbraun; die Dunkelfärbung ist nicht scharf von der hellen Partie getrennt, sondern geht allmählich darin über . . . *cribripennis* C. O. WAT.
   Prothorax schwarz, auf den Elytren sind die Farbenpartieen scharf quer getrennt 2
2. Prothorax halbelliptisch, Schildchen am Hinterrand nicht gespalten, Elytren nur unmittelbar am Hinterrand schwarz . . . *beccarii* BOURG.
   Prothorax viel breiter als lang, Schildchen in zwei Spitzen auslaufend, tief gespalten, Spitzendrittel der Elytren schwarz . . . . *pilosus* n. sp.

Ditoneces C. O. WATERHOUSE.

Ill. Typ. Spec. Col. I, Lycid. 1879, p. 31.

definitivus KLEINE.
Treubia IX, Nr.4,1926,p.301,Taf.VIII,Fig.95.
Noesa Kambangan; G. Telemojo, ein Nebenberg des G. Merbaboe, ruhender Vulkan in M. Java (DRESCHER); Soember Pakel, Dampit; Banjoewangi (MAC GILLAVRY).

rufescens C. O. WATERHOUSE.
Ill. Typ. Spec. Col. I, Lycid. 1879, p. 31, Taf. VII, Fig. 8.
Karang Bolong, niedriges Gebirge direkt an der Südküste Javas, Reste eines alten, gewaltigen Vulkans; G. Oengaran, ruhender Vulkan, Nordküste, direkt oberhalb Samarang. (DRESCHER).

Fig. 20. *Ditoneces versicolor*, n. sp. Prothorax und 1.—5. Fühlerglied.

versicolor n. sp. (Fig. 20).

Schwarz, Hüften und Schenkel auf der unteren Kante wenigstens in der basalen Hälfte gelblich, Kopf gelbbraun, Prothorax, Schildchen und Elytren hell strohgelb. — Stirn wenig breiter als ein Augenhalbmesser, flach eingesenkt, Fühlerbeulen schwach entwickelt, fast unskulptiert. — Fühler sehr zart, Lamellen beim ♂ länger als das Glied selbst, grob und tief skulptiert und abstehend weisslich behaart, Behaarung an den Lamellen länger als am Stiel. — Prothorax mit den Rändern überall, aber nur schwach aufgebogen, Randpunktierung am Vorderrand und in den Hinterecken am stärksten, Mittelfurche bis über die Hälfte hinausgehend, Behaarung sehr kurz. — Schildchen zungenförmig, am Hinterrand gerade. — Elytren mit deutlichen Rippen und scharf ausgebildeter Furchenpunktierung, die aus vorherrschend 5 eckigen Figuren besteht, Behaarung

schwach. — Fühler des ♀ kräftig gezahnt, nach vorn an Breite, nicht an Länge abnehmend, Spitzenglied das längste, Behaarung kräftig, aber nicht so lang wie beim ♂.

Länge: 7 mm, Breite (hum.): 1,5 mm.

G. Tangkoeban Prahoe IX.28 und X.29. (DRESCHER).

1 ♂, 1 ♀ Typen in meiner Sammlung.

turbidus n. sp. (Fig. 21).

Schwarz, Prothorax, Schildchen und Elytren gelb- bis rotorange, kurz, einzeln behaart. — Stirn etwas breiter als ein Augenhalbmesser, vor den Fühlerbeulen breit, aber nur flach eingesenkt. — Fühler sehr zart, Lamellen der männlichen Glieder so lang wie das Glied selbst, schmal, weibliche Glieder tief gezahnt, Behaarung, namentlich an den Lamellen, sehr lang und einzeln. — Prothorax am Hinterrand breiter als in der Mitte hoch, basaler Mitteleindruck breit, tief, Seitenränder aufgebogen, Randpunktierung am Vorder- und Hinterrand deutlich, sonst schwach. — Schildchen lang, zungenförmig, am Hinterrand flach eingebuchtet. — Elytren mit schwacher Rippenbildung und Gitterung, letztere von vorwiegend fünfeckiger Gestalt, durch Behaarung unscharf.

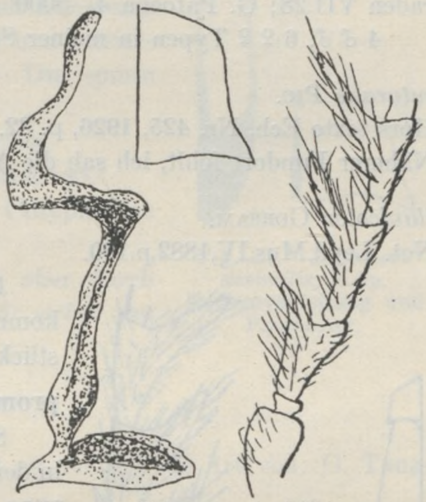

Fig. 21. *Ditoneces turbidus,* n. sp. Penis, Prothorax und 1.—5. Fühlerglied.

Länge: 7—8 mm, Breite (hum.): 1,5 mm.

Java (ohne näheren Fundort), von W. ROEPKE gesammelt.

3 ♂♂, 1 ♀ Typen in meiner Sammlung.

punctipennis C. O. WATERHOUSE.

Trans. Ent. Soc. 1878, p. 100 & 108.

Der Autor gibt keinen näheren Fundort an. Ich sah folgende Belege: G. Telemojo, ein Seitenberg des G. Merbaboe, ruhender Vulkan in M. Java; G. Gedeh, Vulkan im Preanger, West-Java (DRESCHER); Malang, Ost Java (KOLLAR-Leiden).

Fig. 22. *Ditoneces preangeranus,* n. sp. Penis.

preangeranus n. sp. (Fig. 22).

Schwarz, Schenkel in der basalen Hälfte unterseits, Kopf, Prothorax, Schildchen und Elytren hell orange bis schmutzig gelb. — Stirn etwas breiter als ein Augenhalbmesser, sehr schwach vertieft, Fühlerbeulen wenig entwickelt, Augen gross. — Fühler wie bei *nigrosuturalis.* — Prothorax höher als breit, Vorderrand dachförmig abfallend, Vorderecken stumpf, Seiten hinter der Mitte verengt, Hinterecken schwach vorgezogen, Randpunktierung sehr kräftig und gross, Behaarung zart, Mittelfurche an der Basis

kräftig, nach der Mitte zu schnell verflachend. — Schildchen sehr kurz, verkehrt herzförmig, hinten schwach eingebuchtet, kurz behaart. — Elytren mit etwas undeutlicher Rippen- und Gitterbildung, die durch die dichte Behaarung verdeckt werden.

Länge: 7½—9 mm, Breite (hum.): 2 mm circa.

G. Tangkoeban Prahoe 4—5000′ Preanger (DRESCHER) VI.29. Noesa Kambangan VII.—VIII.27. G. Papandajan, Tjisoeroepan VI.29; G. Slamat, Batoerraden VII.28; G. Patoeha 4—5000′ Preanger VI.29. (DRESCHER).

4 ♂ ♂, 6 ♀ ♀ Typen in meiner Sammlung.

suturalis PIC.
Hors texte Ech. Nr. 425, 1926, p. 32.
Näherer Fundort fehlt, ich sah die Art nicht.

flavicolor GORHAM.
Not. Leyd.Mus.IV,1882,p.100.

Die Art ist von Sumatra beschrieben, sie kommt aber auch auf Java vor. Ich sah Belegstücke von Noesa Kambangan (DRESCHER).

Fig. 23. *Ditoneces promiscuus*, n. sp. Farbenverteilung, Prothorax und 1.—6. Fühlerglied.

promiscuus n. sp. (Fig. 23).

Schwarz, Prothorax, Schildchen und Elytren in den vorderen ⅔ orangerot, die schwarze Zeichnung gegen den Aussenrand einförmig vorgezogen, am ganzen Körper kurz behaart. — Stirn 1½ mal so breit wie ein Augenhalbmesser, über den Augen breit vertieft, Skulptur gering. — Fühler beim ♂ wahrscheinlich lang pectinat. — Prothorax am Hinterrand etwas breiter als in der Mitte hoch, Seitenränder stärker aufgebogen als die übrigen, Basaleindruck breit, flach, nach vorn in eine kurze, flache Mittelfurche verlängert, Randpunktierung sehr stark, in der Punktierung lang behaart. — Schildchen verkehrt herzförmig, an der Basis lang behaart. — Elytren mit deutlicher Rippen- und Gitterbildung, Gitterung vorherrschend fünfeckig, zuweilen lang rechteckig.

Länge: 8,5 mm, Breite (hum.): 1,5 mm.

Java (ohne näheren Fundort), von W. ROEPKE gesammelt.

1 ♀ Typus in meiner Sammlung.

Es steht leider kein ♂ zur Verfügung, um die Gestalt des Penis festzulegen. Dass es sich aber um einen *Ditoneces* und nicht um einen *Plateros* handelt, ist auch am weiblichen Tier durch die tief gezahnten Fühler erwiesen.

assimilis n. sp. (Fig. 24).

Schwarz, Prothorax und Schildchen schmutzig orangerot, Elytren in den

vorderen ⅔ von der gleichen Farbe, hinteres ⅓ schwarz, die schwarze Partie nach der Sutura und dem Aussenrand vorgezogen. — Stirn doppelt so breit wie ein Augenhalbmesser, tief halbkreisförmig eingedrückt, die Ränder neben den Augen erhaben, Skulptur gering. — Fühler ähnlich wie bei *promiscuus*. — Prothorax quer, mit deutlicher Mittelfurche, die bis ins vordere ⅓ reicht, alle Ränder mässig aufgebogen, die seitlichen am meisten. — Schildchen zungenförmig, länger als breit, am Hinterrand nur wenig eingekerbt. — Elytren mit flacher Rippen- und Gitterbildung, Gitterung meist quadratisch. — Die ganze Oberseite ist dicht, filzig behaart.

Länge: 8 mm, Breite (hum.) 1,5 mm circa.

W. Java: Pengalengan 4000′ (H. FRUHSTORFER).

2 ♀♀ Typus in meiner Sammlung, Cotypus im Dahlemer Museum.

Dem *promiscuus* am nächsten stehend, aber durch die angegebenen Unterschiede leicht und sicher zu trennen.

Fig. 24. *Ditoneces assimilis*, n. sp. Farbenverteilung und Prothorax.

rubripennis PIC.

Mél. III, 1912, p. 8.

Der Autor gibt keinen näheren Fundort an, ich sah die Art von: G. Tangkoeban Prahoe (DRESCHER).

nigrosuturalis n. sp. (Fig. 25).

Kleine zierliche Art. Schwarz, Prothorax an den Seiten gelbbraun, Elytren lehmgelb, Sutura vom Schildchen ab schwarz, nach dem Hinterrand zu keilförmig erweitert. — Stirn wenigstens 3 mal so breit wie ein Augenhalbmesser, über den flachen Fühlerbeulen etwas eingesenkt, glatt. — Fühler kräftig, Lamellen der mittleren Glieder beim ♂ etwa so lang oder wenig länger wie der Stiel, kurz, dicht behaart, beim ♀ gedrungener, nur schwach gezahnt, nach vorn an Breite abnehmend, kurz behaart. — Seiten- und Hinterränder des Prothorax stark aufgebogen, Randpunktierung kräftig, basale Mittelfurche am Hinterrand stark vertieft, nach der Mitte zu strichförmig verflacht, Behaarung kurz. — Schildchen verkehrt herzförmig, am Hinterrand flach eingebuchtet, kurz behaart. Elytren mit deutlichen Rippen, Gitterung durch die starke dichte Behaarung verdeckt.

Fig. 25. *Ditoneces nigrosuturalis*, n. sp. Farbenverteilung, Prothorax und 1.—7. Fühlerglied.

Länge: 5—6 mm, Breite (hum.): 1¼—1½ mm circa.

G. Tangkoeban Prahoe 4—5000′ Preanger IX.28, X.29. (DRESCHER).

2 ♂♂, 1 ♀ Typen in meiner Sammlung.

acuticollus n. sp. (Fig. 26).

In der Ausfärbung ähnlich *nigrosuturalis*, die Elytren aber nur am Hinterrand verdunkelt. — Stirn etwa 1½ mal so breit wie ein Augenhalbmesser, an den Fühlerbeulen punktartig vertieft, Fühlerbeulen kräftig. — Fühler des ♂ sehr schlank, Lamellen kürzer als der Stiel, einzeln lang behaart und kräftig skulptiert, des ♀ schwach gezähnt, nach vorn zu schmaler werdend, kurz behaart. — Prothorax 3eckig, Hinterecken auffällig stark entwickelt und nach hinten vorgezogen, alle Ränder etwas aufgebogen, Randpunktierung sehr kräftig und gross, basale Mittelfurche kurz und tief. — Schildchen verkehrt herzförmig, hinten flach eingebuchtet, zart behaart, auf den Elytren sind die Rippen unscharf erkennbar, die Gitterung durch dichte Behaarung verdeckt.

Fig. 26. *Ditoneces acuticollis*, n. sp. Farbenverteilung, Prothorax und 1.—5. Fühlerglied.

Länge: 6 mm, Breite (hum.): 1½ mm circa.

G. Tangkoeban Prahoe 4—5000′, Preanger IX.28, X.28. (DRESCHER).

1 ♂, 2 ♀ ♀, Typen in meiner Sammlung.

erythropterus n. sp. (Fig. 27).

Schwarz, Elytren blutrot, am Hinterrand in geringem Umfange schwarz, zuweilen ohne Schwarzfärbung, die schwarzen Körperteile hoch glänzend, am ganzen Körper dicht behaart. — Stirn doppelt so breit wie ein Augenhalbmesser, über den Fühlerbeulen halbkreisförmig vertieft. — Fühler des ♂ vom 3. Glied ab mit kurzen Lamellen, 3. und 4. Glied unter sich gleich lang, aber länger als das 4. und 5., die ungefähr von gleicher Länge sind, vom 6. ab werden die Glieder länger und schmäler, die Lamellen kürzer, 11. kaum länger als das 10., alle Glieder kräftig skulptiert und lang abstehend behaart, Fühler des ♀ schlanker und zarter, keine Lamellen, Behaarung schwach. — Prothorax-Seitenränder stark aufgebogen, Randpunktierung sehr kräftig, Mitte in der Basalhälfte mit deutlicher Mittelfurche. — Schildchen zungenförmig, schwach gefurcht, hinten fast gerade. — Elytren mit deutlichen Rippen, die feine Furchenpunktierung ist durch dichte Behaarung verdeckt.

Fig. 27. *Ditoneces erythropterus*, n. sp. Prothorax und 1.—4. Fühlerglied.

Länge: 9 mm, Breite (hum.): 2 mm.

G. Slamat, Batoerraden, VII. 1928. (DRESCHER).

G. Tangkoeban Prahoe 4—5000′ (Preanger) V.28, VIII.28, VI.29, VIII.29 und IX.29 (DRESCHER).

1 ♂ 9 ♀ ♀ Typen in meiner Sammlung.

Uebersicht über die Arten.

1. Prothorax rot, orange oder gelblich 2
Prothorax schwarz oder braunschwarz 11
2. Elytren einfarbig 3
Elytren zweifarbig 8
3. Farbe der hellen Körperteile rot oder orange 4
Farbe der hellen Körperteile gelb oder lehmgelb in Abstufungen . . 5
4. Prothorax mit rundem Vorderrand, Seiten nach hinten geradlinig erweitert, Kopf schwarzbraun, männliche Fühlerglieder mit kräftigen Lamellen, die länger als das Glied sind . . . . *definitivus* Kln.
Prothorax mit dachförmigem Vorderrand, Seiten hinter der Mitte nach innen geschwungen, Hinterecken spitz vorgezogen, Kopf gelb, Lamellen etwa ½ so lang als das Glied . . . . *rufescens* C. O Wat.
5. Lamellen der männlichen Fühler länger als das Glied 6
Lamellen kürzer als das Glied 7
6. Körperoberseite hellgelb, Prothorax höher als breit, durchgehend gefurcht, Vorderrand unmerklich in den Seitenrand übergehend, Elytren mit deutlichen Rippen und gleicher Gitterung . . *versicolor* n. sp.
Körper oberseits gelborange, Prothorax quer, nur am Hinterrand mit kurzer Längsfurche, Vorderecken deutlich entwickelt, Seiten auch innen geschwungen, Elytren mit obsoleten Rippen und ganz verschwommener Gitterung . . . . *turbidus* n. sp.
7. Prothorax an den Seiten gerade, vor dem Hinterrand nicht verengt, Hüften und Schenkelbasis hellgefärbt . . . . *punctipennis* C. O. Wat.
Prothorax vor dem Hinterrand verengt, Hüften und Schenkel an der Basis gelblich . . . . *preangeranus* n. sp.
8. Die Elytren sind nicht nur im Spitzenteil, sondern auch an der Sutura schwarz gefärbt . . . . *suturalis* Pic.
Die Elytren sind nur im Spitzenteil verdunkelt 9
9. Die Elytren sind gelb, der Hinterrand ist nur schwach angedunkelt *flavicolor* Gorh.
Die Elytren sind rotorange, die Schwarzfärbung ist ausgedehnter 10
10. Prothorax quadratisch, Mittelfurche fehlt, Lamellen der männlichen Fühlerglieder so lang wie das Glied und nicht dicht stehend . . . *promiscuus* n. sp.
Prothorax quer, Mittelfurche fast durchgehend, Lamellen kurz, dicht stehend . . . . *assimilis* n. sp.
11. Elytren einfarbig . . . . *rubripennis* Pic.
Elytren zweifarbig 12
12. Ausser dem Spitzenteil ist auch die Sutura schwarz . *nigrosuturalis* n. sp.
Nur der Spitzenteil ist schwarz 13
13. Elytren orangerot, die Schwarzfärbung ist nach der Sutura zu verlängert *acuticollis* n. sp.

Elytren blutrot, die Schwarzfärbung liegt nur ganz schmal am Hinterrand . . . . *erythropterus* n. sp.

Melampyrus C. O. WATERHOUSE.

Ill. Typ. Spec. Col. I, Lycid. 1879, p. 30.

pulchellus BOURGEOIS.
Ann.Mus.Civ.Stor.Nat.Gen.XVIII,1883,p.635.
Buitenzorg (LANDSBERGE). Ich sah die Art nicht.

nigroapicalis PIC.
Hors texte Ech. Nr. 405, 1921, p. 5.
Kein näherer Fundort, ich sah die Art nicht.

UEBERSICHT ÜBER DIE ARTEN.

Der helle Teil der Elytren ist blutrot gefärbt, Prothorax quadratisch . . *pulchellus* BOURG.
Der helle Teil ist lehmgelb gefärbt, Prothorax breiter als lang . . . *nigroapicalis* PIC.

Plateros BOURGEOIS.

Compt. Rend. Soc. Ent. Belg. 1897, p. XIX.

brevesuturalis PIC.
Hors texte Ech. Nr. 405, 1921, p. 5.
Preanger. Ich sah die Art noch nicht.

rufescens C. O. WATERHOUSE.
Ill. Typ. Spec. Col. I, Lycid. 1879, p. 31, Taf. VII, Fig. 8.

Java ohne nähere Fundortangabe, ich sah die Art auch von dort ohne genaue Fundortangabe aus Sammlung ROEPKE.

consociatus KLEINE.
Treubia VIII, Nr. 3/4, 1926, p. 466, 2 Fig.
Die mir vorliegenden Stücke hatten keine genaue Fundortangabe.

Fig. 28. *Plateros testaceohumeralis*, n. sp.
1.—4. Fühlerglied, Prothorax und Farbenverteilung.

jacobsoni KLEINE.
Treubia IX, Nr. 4, 1926, p. 296, Taf. VIII, Fig. 88.
Semarang (E. R. JACOBSON).

testaceohumeralis n. sp. (Fig. 28).

Schwarz, nur die Elytren im basalen Viertel und die Hinterecken des Prothorax graugelb, Glanz allgemein kräftig. — Stirn gewölbt mit deutlicher Mittelfurche, über den Fühlerbeulen nur ganz schwach vertieft, die Fühlerbeulen länger als breit, schwach gefurcht, Augen klein. — Fühler vom 3. Glied ab gezähnt, kurz behaart. — Prothorax viel breiter als hoch, Vorderrand gerundet, Vorderecken deutlich, Seiten

schwach nach innen gebogen, Hinterecken nicht vorgezogen, Basaleindruck kräftig, Randpunktierung tief und groß, Schildchen quadratisch, Hinterrand gerade. — Auf den Elytren sind Rippen und Gitterung nicht sehr stark, aber doch deutlich entwickelt und durch die Behaarung nicht verdeckt.

Länge: 4 mm, Breite (hum.): 1 mm circa.

Banaran 13. XI. 16. Sammler: W. ROEPKE.

Typus ♀ in meinem Besitz.

UEBERSICHT ÜBER DIE ARTEN.

1. Prothorax orange oder lehmgelb 2
   Prothorax schwarz 4
2. Elytren dunkel, Humerus mit grossem, purpurrotem Fleck . . . . *brevesuturalis* PIC.
   Elytren einfarbig orange 3
3. Beine pechschwarz . . . . *rufescens* C. O. WAT.
   Hüften und Schenkelbasis gelbbraun . . . . *consociatus* KLN.
4. Elytren gelbbraun, Fühler schlank . . . . *jacobsoni* KLN.
   Elytren schwarz, nur das basale $\frac{1}{4}$ graugelb, Fühler gedrungen . . *testaceohumeralis* n. sp.

Lygistopterinae.

Calochromus GUÉRIN MÉNÉVILLE.

Ann. Soc. Ent. Fr. 1833, p. 158.

semilimbatus PIC.

Mél. XVIII, 1916, p. 16.

Keine nähere Fundortangabe; ich sah die Art nicht.

segregatus C. O. WATERHOUSE.

Ill. Typ. Spec. Col. I, Lycid. 1879, p. 5, Taf. I, Fig. 8. 8a.

Kein genauer Fundort angegeben; ich sah die Art nicht.

armitagei PIC.

Bull. Soc. Ent. Fr. 1916, p. LXXXIX.

Ausser den Stücken des Autors sah ich keine Belege, näherer Fundort fehlte.

subflabellatus PIC.

Hors texte Ech. Nr. 433, 1928, p. 61.

Mir lag die Art aus DRESCHERS Ausbeute von Noesa Kambangan vor.

holtzi PIC.

Echange Nr. 349, 1914, p. 7.

Vom gleichen Fundort.

pallidipennis KLEINE.

Treubia IX, Nr. 4, 1926, p. 294, Taf. VI, Fig. 1.

Ohne näheren Fundort (SOMMER). Die Art sah ich auch von Borneo: Kuching, Sarawak.

elongatus PIC.

Mél. XVIII, 1916, p. 15.

Ich sah die Art mehrfach vom Preanger (WARBURG, SIJTHOFF), ferner G. Tangkoeban Prahoe 4—5000′; G. Patoeha 5000′ (DRESCHER). Sicheres Material lag mir ausserdem von der Insel Alor vor. Die Verbreitung ist also ziemlich gross.

diversicornis PIC.
Bull. Soc. Zool. XLI, p. 24.
Palabuan, ich fand die Art nicht vor.

viridicollis PIC.
Mél. VII, 1913, p. 7.
G. Tengger (FRUHSTORFER); Noesa Kambangan (DRESCHER). Die Art ist auch auf Bali festgestellt.

melanurus C. O. WATERHOUSE.
Cistul. Ent. II, 1877, p. 196.

WATERHOUSE gibt in den Ill. Typ. Spec. Col. Java an. Das mir vorgelegene umfangreiche Material hat Java niemals bestätigt. Sichere Fundorte sind mir bekannt von der Malayischen Halbinsel; Pahang, Selangor, selbst Ober-Assam, Johore, Singapore, also die ganze Halbinsel. Demzufolge ist auch Sumatra und Borneo besetzt. Letztere Insel ist von Nord bis Süd bewohnt. Java ist doch wohl mit Fragezeichen zu versehen. Dabei ist die Art leicht erkenntlich und kollidiert mit keiner anderen.

drescheri KLEINE.
Treubia (im Druck).
G. Tangkoeban Prahoe 4—5000′, Preanger (DRESCHER).

vestitus C. O. WATERHOUSE.
Cistul. Ent. II, 1877, p. 200.

Von Pahang beschrieben. Ich sah ein Exemplar von DRESCHER auf Java gesammelt: G. Tangkoeban Prahoe. Es ist fraglich, ob es sich tatsächlich um *vestitus* handelt. Der Fundort spricht nicht dafür. Ich konnte das Stück aber vorläufig nicht anders unterbringen.

lepidus C. O. WATERHOUSE.
Cistul. Ent. II, 1877, p. 201.

Der Autor gibt Java und Penang an. Von W. Java sah ich aus der Ausbeute von DRESCHER: Koebangkangkoeng, Res. Banjoemas.

Die bei *melanurus* angegebenen Zweifel sind auch hier nicht von der Hand zu weisen. Ich sah von *lepidus* noch kein Stück von Penang oder den nahestehenden Insel Sumatra und Borneo.

compressicornis PIC.
Hors texte Ech. Nr. 420, 1925, p. 15.
Näherer Fundort fehlt, mir lag die Art nicht vor.

fruhstorferi PIC.
Echange Nr. 343, 1913, p. 147.
Ich sah Belege vom G. Tengger aus Sammlung FRUHSTORFER.

UEBERSICHT ÜBER DIE ARTEN.

1. Prothorax einfarbig rot, orange, gelb oder lehmgelb 2
Prothorax bunt, die unter 2 angegebenen Farben immer mehr oder weniger durch schwarz unterbrochen . . . . *semilimbatus* PIC.
Prothorax schwarz, schwarzblau, metallisch, braunschwarz, grün oder schwarzgrün 5
2. Die Oberseite des Körpers ist mit Ausnahme des schwarzen Schildchens orangerot . . . . *segregatus* C. O. WAT.
Elytren zweifarbig 3
3. Unterseite des Körpers, Kopf und Fühler schwarz, ohne blauen Glanz *armitagei* PIC.
Die dunklen Körperteile sind mehr oder weniger metallisch gefärbt 4
4. Fühlerglieder des Mannes mit Lamellen . . . . . *subflabellatus* PIC.
Fühlerglieder tief gezahnt . . . . *holtzi* PIC.
5. Elytren einfarbig gelb, rot oder orange ohne schwarze Zeichnung 6
Elytren mit schwarzer Zeichnung 9
6. Die hellgefärbten Körperteile sind gelbbraun, lehmgelb oder von ähnlicher Tönung 7
Die hellgefärbten Körperteile sind rot oder orange in allen Uebergängen 8
7. Die dunklen Körperteile sind blaumetallisch, Fühlerglieder aufsitzend, dicht . . . . *pallidipennis* KLN.
Die dunklen Körperteile sind schwarz, höchstens mit undeutlichem blauen Schimmer, Fühlerglieder locker stehend . . . . *elongatus* PIC.
8. Prothorax mit tiefen Eindrücken, Fühler nicht hochglänzend, die dunklen Körperteile sind schwarzgrau, nicht stahlblau *diversicornis* PIC.
Prothorax flach, Fühler glänzend, die dunklen Körperteile sind stahlblau . . . . *viridicollis* PIC.
9. Die Verdunklung auf den Elytren ist nur schmal am Hinterrand . . 10
Die Verdunklung umfasst wenigstens das hintere Viertel . . . . *melanurus* C. O. WAT.
10. Die helle Partie auf den Elytren ist carmin bis purpurrot *drescheri* KLN.
Die helle Partie ist heller rot gefärbt 11
11. 3. Fühlerglied kürzer als das 4. . . . . *vestitus* C. O. WAT.
Nicht kürzer 12
12. Prothorax quadratisch . . . . *lepidus* C. O. WAT.
Prothorax quer 13
13. Fühlerglieder vom 3. ab eingedrückt . . . . . . *compressicornis* PIC.
Fühlerglieder nicht eingedrückt . . . . *fruhstorferi* PIC.

Dilophotinae.

Lyropaeus C. O. WATERHOUSE.

Trans. Ent. Soc. 1878, p. 105.

longipennis PIC.
Echange Nr. 320. 1911, p. 166.

Der Autor gibt keinen näheren Fundort an. Ich sah mehrere Belegstücke aus DRESCHERS Ausbeute von: G. Patoeha 5000′; G. Tangkoeban Prahoe 4—5000′, Preanger; G. Slamat, Batoerraden.

bicolor PIC.
Echange Nr. 321, 1921, p. 166.
Kein näherer Fundort; ich sah die Art nicht.

binotatus PIC.
Wie vor.

UEBERSICHT ÜBER DIE ARTEN.

1. Prothorax schwarz . . . . *longipennis* PIC.
   Prothorax bunt 2
2. Prothorax an den Seitenrändern rot, Elytren im Spitzenteil schwarz *bicolor* PIC.
   Prothorax am Hinterrand rot, Elytren im Spitzenteil nur unscharf, schwach angedunkelt . . . . *binotatus* PIC.

Libnetis C. O. WATERHOUSE.

Trans ent. Soc. 1878, p. 104.

tumidus n. sp. (Fig. 29).

Unterseite des Körpers, Beine und Fühler ganz schwarz, Prothorax grau, Hinterrand gelblich, Schildchen schwarz, Elytren lehmgelb, Hinterrand in geringer Ausdehnung graubraun. — Stirn über den flachen Fühlerbeulen eingedrückt, hell behaart. — 1.—5. Fühlerglied Abb. 29, Glieder nach vorn an Länge abnehmend, 11. nicht länger als das 10. — Prothorax stark quer, Vorderrand geschwungen, Vorderecken rund, Hinterecken spitz, Mittelkiel schwach, Randpunktierung gross, tief, durch die Behaarung etwas verdeckt. — Schildchen verkehrt-herzförmig, Hinterrand gelb behaart. — Elytren mit deutlichen Rippen, 2. und 4. kräftiger entwickelt als die 1. und 3., die gegen den Hinterrand zu verschwinden, Skulptur unregelmässig, punktartig, Behaarung einzeln.

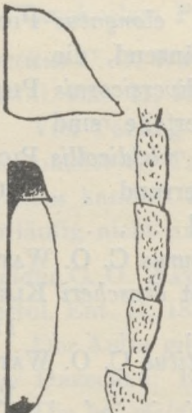

Fig. 29. *Libnetis tumidus*, n. sp. Prothorax, Farbenverteilung und 1.—5. Fühlerglied.

Länge: 8 mm, Breite (hum.): 2 mm.

O. Java: Idjen Plateau 1850 m, Ongop-ongop V. 1924. (K. W. DAMMERMAN).

1 ♂. Typus im Museum Buitenzorg.

Die neue Art ist durch ihre Grösse ausgezeichnet. Von ähnlichen Arten unterscheidet sie sich leicht durch den auffallend breiten Prothorax.

pumilio C. O. WATERHOUSE.
Trans. Ent. Soc. 1878, p. 117.

Ueber den Umfang der Verbreitung dieser Art möchte ich keine Angaben

machen, sie bedürfen erst noch eingehender Nachprüfung. Auf Java scheint sie nicht selten zu sein. Mir lagen folgende Fundorte vor: G. Telemojo; G. Tangkoeban Prahoe 4—5000′ Preanger; G. Slamat, Batoerraden (DRESCHER); Tjibodas (BECCARI).

pallidipennis PIC.

Echange Nr. 321, 1911, p. 166.

Der Autor gibt keinen Fundort an. Ich sah die Art von: G. Tangkoeban Prahoe und G. Patoeha, Preanger (DRESCHER).

sejunctus BOURGEOIS.

Ann. Mus. Civ. Stor. Nat. Gen. XVIII, 1883, p. 648.

Tjibodas (BECCARI).

UEBERSICHT ÜBER DIE ARTEN.

1.	Prothorax bunt	2
	Prothorax schwarz	3
2.	Elytren nur dicht am Hinterrand mit schwarzem Fleck	*tumidus* n. sp.
	Elytren in der ganzen Spitzenhälfte schwarz . . .	*pumilio* C. O. WAT.
3.	Elytren einfarbig lehmgelb	*pallidipennis* PIC.
	Elytren zweifarbig	*sejunctus* BOURG.

Libnetomorphus PIC.

Hors texte Ech. Nr. 404, 1921, p. 2.

lineolatus PIC.

Hors texte Ech Nr. 404, 1921, p. 2.

Kein näherer Fundort; ich sah die Art nicht.

javanicus PIC.

Hors texte Ech. Nr. 420, 1925, p. 11.

Wie vor.

UEBERSICHT ÜBER DIE ARTEN.

Elytren schwarz, Humerus schmal rötlich . . .	*lineolatus* PIC.
Elytren graugelb, hinteres Drittel schwarz . .	*javanicus* PIC.

Flabellodilophotes PIC.

Mél. III, 1912, p. 9.

nigrosuturalis n. sp. (Fig. 30).

Schwarz, Elytren graugelb mit einer am Schildchen beginnenden schwarzen, nach dem Hinterrande allmählich breiter werdenden und die Seitenränder erreichenden keilförmigen Sutura. — Stirn viel breiter als das Auge, gewölbt nur über den Fühlerbeulen, halbkreisförmig, schwach vertieft, Fühlerbeulen kräftig entwikkelt mit flacher Mittelfurche. Mittlere Fühlerglieder 1½ mal so lang wie das Glied selbst, sehr schmal, einzelne lang behaart, Prothorax länger als breit, Seiten parallel, Hinterecken schwach vorgezogen, Randpunktierung kräftig, sonst glatt. — Schildchen parallel, am Hinterrande nicht eingebuchtet. — Auf den Elytren

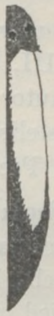

Fig. 30. *Flabellodilophotes nigrosuturalis*, n. sp. Farbenverteilung

sind die Rippen durch die dichte filzige Behaarung stark verdeckt. — Beim ♀ sind die Fühlerglieder gedrungener und stark gezähnt.

Länge: 6—7 mm, Breite (hum.): 1,25 mm circa.

W. Java, Pengalengan, Taloen, IX. 09. Sammler: W. ROEPKE.

Typen ♂ und ♀ in meinem Besitz.

dispar n. sp. (Fig. 31).

Schwarz, Elytren in den vorderen ⅔ schmutzig zinnoberrot. — Stirn mit schmaler tiefer Mittelfurche, Fühlerbeulen schwach entwickelt. — Fühler des ♂ vom 3.—10. Glied mit Lamellen versehen, 3. Glied ganz ohne Lamellen, am 4. sind die Lamellen 3 mal so lang als der Stiel, an den vorderen Gliedern erreichen die Lamellen wenigstens die 4fache Länge des Stieles, Endglied fast so lang wie die Lamelle des 10. Gliedes, Lamellen sehr schmal, Behaarung kurz und dicht, Fühler des ♀ vom 4.—10. Glied tief gezahnt, fast mit kurzen Lamellen. — Prothorax in der Randpartie und an den Hinterecken tief punktiert. — Schildchen breiter als lang, am Hinterrand gerade. — Auf den Elytren reicht die 1. Rippe nicht über die Mitte, die 2. und 3. erreichen fast den Hinterrand, Skulptur aus sehr feiner unregelmässiger Punktierung bestehend, die durch die Behaarung nicht verdeckt wird.

Fig. 31. *Flabellodilophotes dispar,* **1.—6. Fühlerglied.**

Länge: 7—8½ mm, Breite (hum.): 2 mm circa.

G. Tangkoeban Prahoe 4—5000′, Preanger (DRESCHER) VIII. — IX. 28., VI. 29.

1 ♂, 2 ♀ ♀ Typen in meiner Sammlung.

Dilophotes C. O. WATERHOUSE.

Ill. Typ. Spec. Col. I, Lycid. 1879, p. 75.

fruhstorferi PIC.

Mél. III, 1912, p. 8.

Autor gibt keine nähere Fundortangabe. Ich sah folgenden Belegstellen: G. Tangkoeban Prahoe 4—5000′ und G. Patoeha 5000′, Preanger (DRESCHER).

monticola n. sp. (Fig. 32).

Schwarz, nur die Elytren lehmgelb. — Stirn nur ganz schwach verflacht, Fühlerbeulen wenig entwickelt. — Fühler schlank, vom 3. Glied ab nach vorn an Länge und Breite abnehmend, die Glieder ungezahnt, dicht aufsetzend, Behaarung sehr kurz. — Prothorax ohne besondere Merkmale. — Schildchen verkehrt herzförmig, am Hinterrand fast gerade, zart skulptiert — Auf den Elytren ist die 1. Rippe in der hinteren Hälfte unscharf und verschwindet schliesslich ganz, 2. und 3. Rippe bis dicht an den

Fig. 32. ***Dilophotes monticola,* n. sp. 1.—5. Fühlerglied.**

Hinterrand reichend, ohne denselben direkt zu berühren, Punktierung durch die dichte Behaarung mehr oder weniger verdeckt und undeutlich.

Länge: 7—9 mm, Breite (hum.): 2 mm circa.

G. Tangkoeban Prahoe 4—5000′, Preanger XI. 28., XII. 28., IX. 29. (DRESCHER).

6 ♀♀ Typus in meiner Sammlung.

Die Art unterscheidet sich leicht von allen anderen durch die einfarbigen lehmgelben Elytren, durch die Grösse und die schlanken Fühler, deren Glieder keinerlei Neigung zu Zahnbildung erkennen lassen.

rubripennis PIC.
Mél. III, 1912, p. 8.

Ich sah die Art aus DRESCHERS Ausbeute von G. Tangkoeban Prahoe 4—5000′, Preanger.

notatipennis PIC.
Mél. XXXIII, 1921, p. 15.
Kein näherer Fundort; ich sah die Art nicht.

apicalis PIC.
Mél. XXXIII, 1921, p. 15.
W. Java: Pengalengan (Autor); Batoerraden, G. Slamat; G. Tangkoeban Prahoe, (DRESCHER).

shelfordi BOURGEOIS.
Ann. Soc. Ent. Fr. LXXV, 1906, p. 194.
O. Java, Idjen Plateau, Kendeng Geb. (LUCHT); W. Java, G. Tangkoeban Prahoe, und G. Slamat, Batoerraden (DRESCHER). Auf Borneo häufig. Die Stücke von Java hat PIC als v. *rufonotatus* beschrieben.

UEBERSICHT ÜBER DIE ARTEN.

1. Prothorax rot . . . . *fruhstorferi* PIC.
   Prothorax schwarz oder schwarzbraun, zuweilen hell behaart . . . 2
2. Elytren einfarbig 3
   Elytren in der Spitzenhälfte immer mehr oder weniger schwarz . . . 4
3. Elytren lehmgelb . . . . *monticola* n. sp.
   Elytren blutrot . . . . *rubripennis* PIC.
4. Elytren im hellgefärbten Basalteil mit dunklen Aussenrippen . . *notatipennis* PIC.
   Rippen nicht dunkel markiert 5
5. Auf den Elytren nimmt die schwarze Zeichnung nur $^1/_5$ der ganzen Länge ein, Prothorax gelb, dicht behaart . . . . *apicalis* PIC.
   Die schwarze Zeichnung reicht bis über die Hälfte, Prothorax pechschwarz mit mattem Glanz . . . . *shelfordi* BOURG. var. *rufonotatus* PIC.

(Nachtrag zur Lycidenfauna Javas).

Nachdem ich das Manuskript über die Lycidenfauna Javas abgeschlossen und abgesandt hatte, erhielt ich von Herrn DRESCHER eine recht inhaltreiche Sendung, in der die nachstehend beschriebenen 4 Arten neu waren. Ich gebe sie hier im Nachtrag zur Vervollständigung des Faunenbildes noch bekannt.

Calochromus pyrochroides n. sp. (Fig. 33).

Schwarz, Prothorax und Elytren bis über die Hälfte ziegelrot. — Stirn mit flacher Mittelfurche, einzeln, rot behaart.

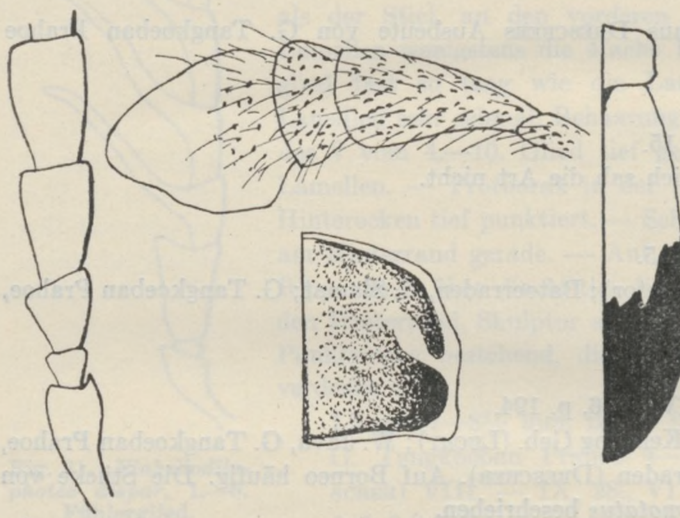

Fig. 33. *Calochromus pyrochroides*, n. sp.
1.—5.Fühlerglied, Mandibulartaster, Prothorax und Farbenverteilung.

Fühler schlank, 3. Glied nur etwa halb so lang wie das 4., 4.—10. fast gleichlang, nach vorn an Breite abnehmend, 11. länger als das 10., grob skulptiert und kurz behaart. — Prothorax breiter als lang, Mittelfurche sehr schmal und nur wenig deutlich, im vorderen Drittel ganz fehlend, Behaarung überall dicht und kräftig. — Schildchen zungenförmig mit deutlicher Mittelfurche. — Elytren parallel, alle Rippen sind entwickelt, Behaarung, namentlich auf den Rippen, dicht und lang. — Schenkel ungedornt.

Länge: 13 mm, Breite (hum.): 3 mm.

G. Tangkoeban Prahoe 4000—5000′ Preanger. (DRESCHER).

Typus ♀ in meiner Sammlung.

Die neue Art sieht dem *bicoloratus* KLN. von Sumatra sehr ähnlich und ist damit zu vergleichen. Die Differenzen sind folgende:

bicoloratus	*pyrochroides*
3. Fühlerglied wenigstens so lang wie das 4.	3. Fühlerglied nur etwa ½ so lang wie das 4.
Prothorax von viereckiger Gestalt, am Vorderrand breit quer vertieft, Seiten gerade, Mittelfurche bis auf einen kurzen, tiefen Eindruck am Hinterrand völlig fehlend. Schildchen rot.	Prothorax mit runden Vorderecken, keine Vertiefung in der Vorderrandspartie, Mittelfurche zwar schmal, aber doch bis ins vordere Drittel reichend. Schildchen schwarz.

Auf den Elytren reicht die schwarze Färbung bis über die Mitte.

Schwarzfärbung auf den Elytren die Mitte nicht erreichend, nur am Aussenrand etwas nach vorn verlängert.

Trichalus castigatus n. sp. (Fig. 34).

Schwarz, nur der Prothorax an den Seitenrändern und die Primärrippen im vorderen Drittel rotbraun gefärbt. — Stirn vor den flachen, fast wagerecht stehenden Fühlerbeulen mit zwei tiefen Gruben. — 1.—4. Fühlerglied nach vorn an Länge und Breite abnehmend, das 11. etwa so lang wie das 10. — Prothorax mit schwacher Punktierung. — Elytrengitterung von sehr wechselnder Gestalt, quadratisch, querrechteckig und fünfeckig, Rippen und Gitterung scharf ausgebildet, Behaarung gering.

Länge: 9 mm, Breite (hum.): 2 mm circa.

G. Tangkoeban Prahoe 4000—5000′ Preanger. (Drescher).

Typus ♀ in meiner Sammlung.

Durch die Ausfärbung von allen bekannten *Trichalus* leicht zu trennen. Diese Art der Farbenordnung ist bei Lyciden der grossen Sunda-Inseln und Malakkas garnicht selten und ist fast in allen Gattungen mit gegitterten Elytren festgestellt worden. Bei *Trichalus* war diese Erscheinung bisher unbekannt, *castigatus* ist der erste Vertreter und dadurch sicher und leicht festzulegen.

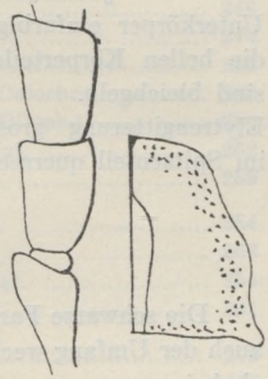

Fig. 34. *Trichalus castigatus*, n. sp.
1.—4. Fühlerglied und Prothorax.

Xylobanus torridus n. sp. (Fig. 35).

Abdomen schwarzbraun, Brust gelbbraun, Beine schwarzbraun mit hellen Hüften, Kopf und Fühler schwarzbraun, Prothorax und Schildchen schmutzig-lehmgelb bis ziegelrot, Elytren von gleicher Farbe, hinteres Viertel mehr oder weniger verdunkelt. — Stirn nur so breit wie ein Augenhalbmesser, flach und breit eingesenkt, Fühlerbeulen flach, Mittelfurche schmal, Augen gross. — Fühler schlank, nach vorn wenig an Länge aber erheblich an Breite abnehmend, 11. Glied nur so lang wie das 10., 4.—10. schwach gezähnt, Behaarung dicht. — Prothorax mit 5 Areolen, diskoidale Areole kräftig entwickelt, sonst nur wenig scharf, Punktierung in der vorderen Areole kräftig, sonst nur schwach. — Schildchen verkehrt herzförmig, tief eingekerbt. — Elytren mit

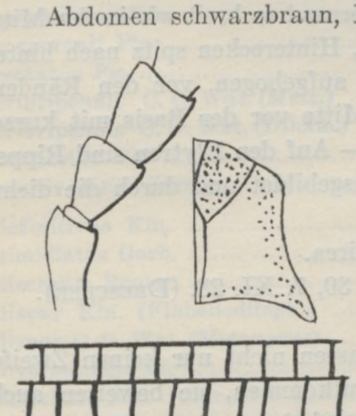

Fig. 35. *Xylobanus torridus* n. sp.
1.—4. Fühlerglied, Prothorax und Elytrengitterung.

kräftigen Rippen und gleicher Gitterung; im hinteren Drittel ist die Gitterung mehr querrechteckig, Behaarung dicht, aber kurz.

Länge: 7 mm, Breite (hum.): 1.5 mm circa.

Süd Banjoemas: Djeroeklegi IV—VII 30. (DRESCHER).

1 ♂, 3 ♀♀. Typen in meiner Sammlung.

Von den *Xylobanus* der Sunda-Inseln ist *goentoerensis* KLN. in Vergleich zu stellen.

goentoerensis	*torridus*
Unterkörper einfarbig schwarzbraun, die hellen Körperteile der Oberseite sind bleichgelb.	Unterkörper zum Teil gelb, die hellen Körperteile der Oberseite sind schmutzig lehmgelb bis ziegelrot.
Elytrengitterung gross, quadratisch, im Spitzenteil querrechteckig.	Elytrengitterung einheitlicher, nicht rein quadratisch, sondern auch querrechteckig, im hinteren Drittel mehr querrechteckig, aber doch auch noch quadratische Figuren bildend.

Die schwarze Farbe auf den Elytren wechselt von tief schwarz bis hellgrau, auch der Umfang wechselt. Bei tiefschwarzer Farbe ist die Abgrenzung schärfer als bei grauer.

Ditoneces mundus n. sp. (Fig. 36).

Rauchbraun bis schwarz, Prothorax, Schildchen und Elytren bleichgelb. — Stirn circa 1½ mal so breit wie ein Augenhalbmesser, vor den Fühlerbeulen in der Mitte vertieft. — Fühler schlank, 3.—10. Glied sehr tief gezähnt, 3. dreieckig, gedrungen, die folgenden schlank und vom 4.—10., von gleicher Gestalt, dicht-kurz und einzeln-lang behaart. — Prothorax am Hinterrand so breit wie in der Mitte hoch, Vorderecken ganz obsolet, Hinterecken spitz nach hinten vorgezogen, alle Ränder stark aufgebogen, vor den Rändern mit einer groben Punktreihe, Mitte vor der Basis mit kurzer Furche, überall dicht behaart. — Auf den Elytren sind Rippen und Gitterung nur unscharf ausgebildet und durch die dichte Behaarung verdeckt.

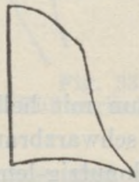

Fig. 36. *Ditoneces mundus*, n. sp. Prothorax.

Länge: 7—8 mm, Breite (hum.): 1.5 mm circa.

G. Tangkoeban Prahoe 4000—5000′ 11. III. 30, 7. XI. 28. (DRESCHER).

2 ♀♀. Typus in meiner Sammlung.

Die stark entwickelten weiblichen Fühler lassen nicht nur keinen Zweifel über die Zugehörigkeit der Art zu *Ditoneces* aufkommen, sie beweisen auch, dass die männlichen Fühler sehr lange Lamellen haben müssen. *Mundus* ist mit *punctipennis* WAT. und *preangeranus* KLN. zu vergleichen. Von *punctipennis* unterscheidet sie sich durch die einfarbig dunklen Beine und den vorn gerundeten und hinten spitz vorgezogenen Prothorax, der den Eindruck macht, dass er länger als breit sei. Bei *punctipennis* ist das Umgekehrte der Fall. Gegen *prean-*

geranus sind die Unterschiede folgende: Beine einfarbig, Fühler (♀) tief gezahnt, fast lamellenartig, Prothorax dreieckig, Vorderecken obsolet, Hinterecken spitz nach vorn vorgezogen.

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ZWEI NEUE INDOMALAYISCHE LYCIDAE

von

R. KLEINE

(Stettin).

[Die nachstehenden zwei Arten, resp. von der Insel Bali und von N.O. Sumatra wurden ursprünglich vom Verfasser in der vorigen Arbeit eingereiht; man wird sie demnach auch in den vorhergehenden Tabellen auffinden. Wir haben diese beiden Arten mit einem anderen Titel der Hauptarbeit folgen lassen.

K. W. DAMMERMAN

Redaktion Treubia.]

Lycostomus baliensis, n. sp. (Fig. 1). Siehe S. 250.

Schwarz, Elytren schmutzig orange, Prothorax von gleicher Farbe mit schwarzer Mitte, stark glänzend, Fühler und Elytren matter. — Rüssel 4 mal so lang als an der Basis breit. — Fühler robust, 4.—10. Glied etwa so lang als breit, tief gezahnt, 3. so lang wie das 4. und 5. zusammen, Behaarung sehr dicht und kurz. — Prothorax dreieckig, an den Hinterecken so breit wie in der Mitte hoch, Seiten stark aufgebogen, Hinterecken spitz vorgezogen, Punktierung nur auf den aufgebogenen Seitenrändern und nur schwach vorhanden. — Schildchen keilförmig, am Hinterrand gerade. — Auf den Elytren sind alle Rippen deutlich entwickelt, 3. vorn und hinten verkürzt, Skulptur flach und durch die Behaarung verdeckt.

Fig. 1. *Lycostomus baliensis* n. sp. Prothorax und mittleres Fühlerglied.

Länge: 14 mm, Breite (hum.): 3 mm.

O.-Bali: Karangasem, X. 1928. (P. F. FRANCK).

1 ♂ Typus im Museum Buitenzorg.

Unter den Arten mit ganz schwarzem Unterkörper und gleich gefärbten Fühlern zeichnet sich *baliensis* durch die kurzen, tief gezähnten Fühlerglieder aus. Der Prothorax erscheint auffällig schmal, was durch die aufgebogenen Seitenränder noch verstärkt wird, der Vorderrand verläuft sehr spitz.

Cladophorus karnyi, n. sp. (Fig. 2). Siehe S. 260.

Tiefschwarz, Elytren ziegelrot, Basis in Länge des Schildchens schwarz, Körperunterseite glänzend. — Kopf ohne besondere Merkmale. — Fühler robust,

3.—10. Glied dicht stehend, tief gezahnt, dicht behaart. — Prothorax am Hinterrand so breit wie in der Mitte hoch, Vorderrand flach abfallend, Vorderecken stumpf, Seiten fast gerade, Hinterecken nur schwach nach aussen vorstehend, Hinterrand geschwungen, Areolen alle sehr deutlich, scharfkantig, Punktierung gross und tief. — Schildchen verkehrt herzförmig, halb elliptisch eingekerbt, dicht behaart. — Elytren mit kräftigen Rippen, Gitterung vorherrschend quadratisch, durch dichte Behaarung mehr oder weniger verdeckt.

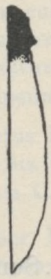


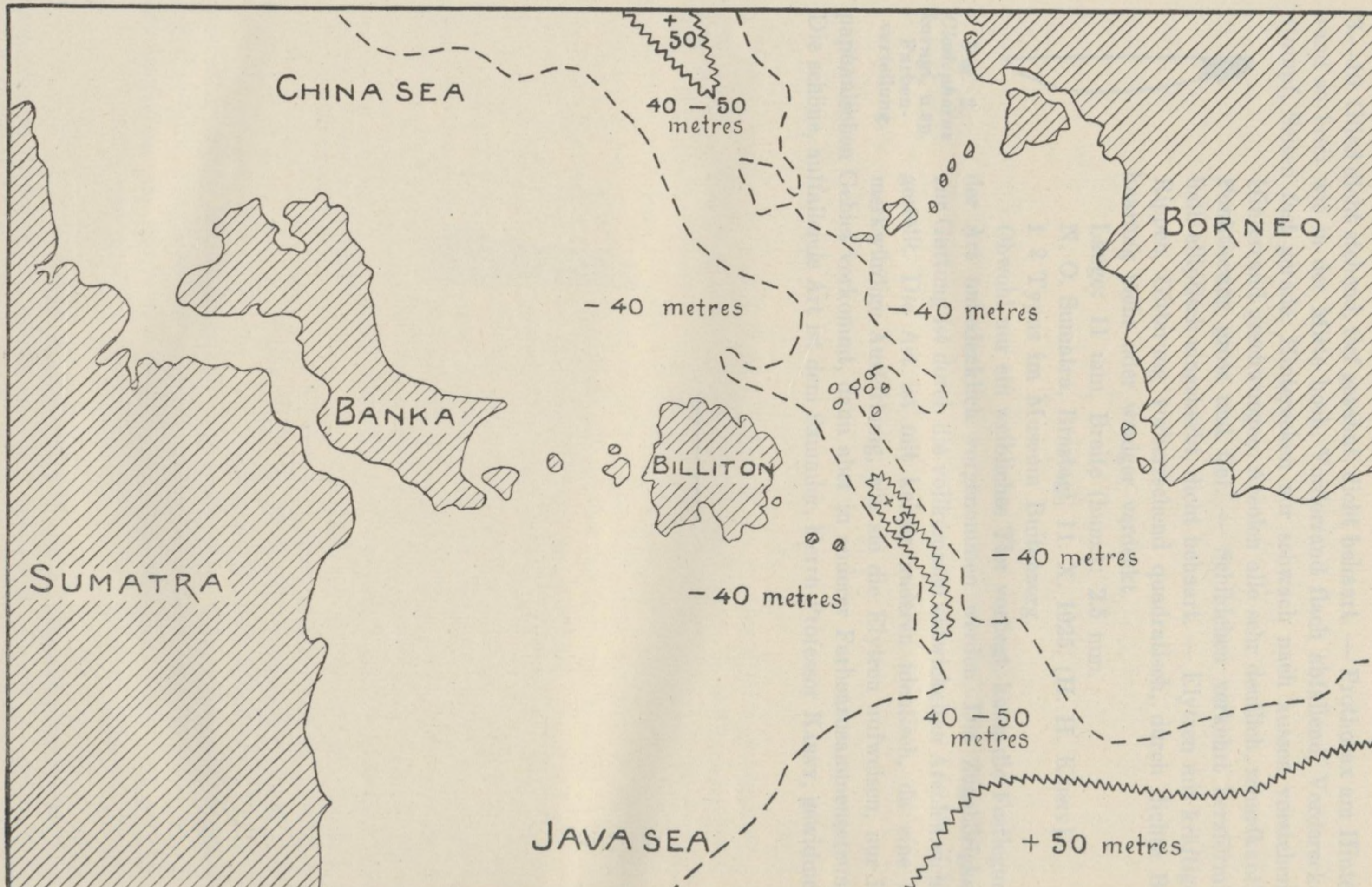
Fig. 2. *Cladophorus karnyi*, n.sp. Farbenverteilung.

Länge: 11 mm, Breite (hum.): 2.5 mm.

N. O. Sumatra, Brastagi, 11. X. 1925, (H. H. KARNY).

1 ♀ Typus im Museum Buitenzorg.

Obwohl nur ein weibliches Tier vorliegt, kann die Festlegung der Art unbedenklich vorgenommen werden. Die Zugehörigkeit zur Gattung ist durch die vollkommen entwickelten Areolen sicher gestellt. Die Art ist mit keiner anderen identisch, da eine so merkwürdige Ausfärbung, wie sie die Elytren aufweisen, nur im papuanischen Gebiet vorkommt, dann aber in anderer Farbenzusammensetzung. Die schöne, auffallende Art ist dem Sammler, Herrn Professor KARNY, gewidmet.



Sketch-map of the islands between Sumatra and Borneo.

SOME BIRDS OF BILLITON ISLAND

by

C. BODEN KLOSS

(Director of Museums, S.S. and F.M.S.).

(With a sketch-map).

The avifauna of Billiton Island, between Sumatra and Borneo, is imperfectly known. Our knowledge of it is almost entirely derived from the collection made in 1888 by DR. A. G. VORDERMAN, of which he published an account in the "Natuurkundig Tijdschrift v. Nederlandsch-Indië" vol. L, 1891, pp. 411 - 519. He discussed ninety-three species.

Dr. W. L. ABBOTT visited the island in 1904 but the birds he obtained and presented to the United States National Museum have not been determined: one new form has been described from them. (*Malacocincla abbotti eritora* OBERH., Smithsonian Miscellaneous Collections, 74, No. 2, 1922, p. 11).

The majority of VORDERMAN's specimens are probably in Holland but a few were given by him to the Zoological Museum, Buitenzorg, Java, whose Director, Dr. K. W. DAMMERMAN, has submitted them to me for examination. A number of the birds having olive or brown plumages have suffered post-mortem changes, but the type and paratype of the new form of *Eurylaimus javanicus* that I have proposed are in very good condition.

Billiton Island, owing to its situation, is of considerable interest. It lies half way between Sumatra and Borneo, within the 40-metre contour line surrounding the former but separated from the latter by slightly deeper water, for to the eastward of the island there runs in a North and South direction a narrow trough with depths of 40 to 50 metres connecting similar and greater depths in the South China and Java Seas. Billiton is, however, zoogeographically the most intimate link we have between the Sumatran and Bornean provinces of Malaysia.

Its fauna should be rather more Sumatran than Bornean in affinities but the forms of *Eurylaimus javanicus, Chotorhea rafflesi, Anuropsis malaccensis* and *Cyanoderma erythroptera* and the presence of *Prionochilus thoracicus* indicate the strong influence of the Bornean province.

1. **Rollulus roulroul** (Scop.). VORDERMANN, p. 510.

   1 ♀. Wing 135 mm.

2. **Turnix suscitator suscitator** Gm.

   Areoturnix plumbipes VORDERM., p. 513.

   1 ♂. Wing imperfect.

   Not separable from typical Javanese males and another from Palembang.

3. **Treron curvirostra curvirostra** (Gm.).
Treron nasica VORDERM., p. 499.
Wing 140 mm.

4. **Treron fulvicollis fulvicollis** (Wagl.). VORDERM., p. 501.
1 ♂, 1 ♀. Wings 150, 148 mm.

5. **Caloenas nicobarica** (Linn.). VORDERM., p. 509.
1 ex. Wing imperfect. From Lima Islet in the Gaspar Straits.

6. **Glareola isabella** Vieill.. VORDERM., p. 515.
1 sex inc., Tandjong Pandan. June 1888. Wing 164; tarsus 45 mm.

The present example does not agree with the measurements given by VORDERMANN so that he probably obtained more than one specimen. There is no dark area before the eye, the breast is mottled with indistinct darkish spots and the longest primary hardly exceeds the next. It is apparently an immature example of the species which is of very rare occurrence in Malaysia.

7. **Accipiter virgatus gularis** (Temm.).
1 ♂ ad., 1 ♂ imm., 1 ♀ ad. (BRAUTIGAM coll., 20 Jan., 2 and 3 March 1914). Wings ♂ imm. 164, ad. 167; ♀ 190 mm.

8. **Psittacula longicauda longicauda** (Bodd.).
Palaeornis longicauda VORDERM., p. 418.
2 ♂. (BRAUTIGAM coll., Jan. 1914). Wings 150, 157 mm.

9. **Eurystomus orientalis orientalis** (Linn.). VORDERM., p. 441.
1 sex inc. Wing 190 mm.

10. **Halcyon coromanda minor** (Temm. & Schleg.).
1 ♂, 1 ♀. (BRAUTIGAM coll.). Wings ♂ 104; ♀ 100 mm.

11. **Halcyon concreta concreta** (Temm.).
Caridagrus concretus VORDERM., p. 437.
1 ♂. Wing 110 mm.

12. **Hierococcyx fugax nisicolor** (Hodgs.).
1 ♀. (BRAUTIGAM coll. 5 March 1914). Wing 172; bill, tip to nostril, 16 mm.

An immature bird with the upper surface dark brown barred with tawny.

13. **Rhopodytes sumatranus** (Raffles). VORDERM., p. 432.
1 sex inc. Wing 136 mm.
A rather small example.

14. **Chotorhea rafflesi** (Less.) subsp.?
Chotorhea versicolor VORDERM., p. 432.
1 sex inc. Wing 123 mm.

A bird with a paler, more turquoise blue eyebrow and throat and size slightly larger than a series from Palembang, South Sumatra (Wings 113 - 120).

It may be just possible to maintain Bornean birds as distinct on account of paler blue colour than in typical Sumatran individuals with which I have only recently been able to compare them: in which case I should place this Billiton example with the former and call it *C. r. borneensis* Blasius (Type locality: S. E. Borneo). But Bornean individuals are not constantly different and I am somewhat doubtful as to whether the use of *borneensis* is justified.

15. **Meiglyptes tukki tukki** (Less.). VORDERM., p. 427.
1 ♂, 1 ♀. Wings 102, 105 mm.

16. **Micropternus brachyurus badius** (Raffles).
Micropternus brachyurus VORDERM., p. 429.
1 ♂, 1 ♀. Wings 115, 113 mm.

17. **Sasia ochracea abnormis** (Temm.). VORDERM., p 430.
1 imm. sex inc. Wing 55 mm.

18. **Eurylaimus javanicus billitonis** subsp. nov.
Eurylaemus javanicus VORDERM., Nat. Tijd. Ned. Ind., L. 1891, p. 441.

Intermediate between *E. j. harterti* VAN OORT, of Sumatra and *E. j. brookei* ROB. & KLOSS, of Borneo. Males differ from the former in having the throat, foreneck, and breast below the black band more vinous (less suffused with lead colour) and the black breast-band narrower, the crown also less leaden: from the latter in having the foreneck rather darker and the breast-band more pronounced: in *brookei* it is obsolete.

Specimens examined. Two males. Collected in Billiton Island on 5th April 1914 by D. F. A. BRAUTIGAM. Buitenzorg Museum Nos. 1158, 1159. Type No. 1159. Wing 108 mm. (Wing of paratype imperfect: 105 mm.).

19. **Eurylaimus ochromalus ochromalus** Raffles.
Eurylaemus ochromelas VORDERM., p. 444.
1 ♀. Wing 77 mm.

20. **Rhinomyias umbratilis** (Strickl.) subsp.
Hyloterpe brunneicauda VORDERM., p. 460.

1 sex inc. in moult. Probably of the typical form which occurs in Borneo, Sumatra and the Malay Peninsula.

21. **Pericrocotus igneus igneus** Blyth.
Pericrocotus ardens VORDERM., p. 456.
1 ♂, 1 ♀. Wings 73, 73 mm.

22. **Aegithina viridissima viridissima** (Bp.).
Iora viridissima VORDERM., p. 470.
3 ♂. Wings 61, 61, 62 mm.

23. **Chloropsis viridis zosterops** Vig.
Phyllornis sonneratii VORDERM., p. 492.
1 ♀. Wing 92 mm.

24. **Chloropsis cochinchinensis icterocephala** (Less.).
Phyllornis icterocephala VORDERM., p. 473.
1 ♂. Wing 81 mm.

The scapulars and rump are strongly washed with Chrysophase green (Ridgway) and the upper tailcoverts are of the same colour, these areas being thus much lighter and brighter than in *icterocephala* (LESS.) of Sumatra and the Malay States. The specimen, however, is in very worn plumage and this may be the cause of the peculiarities shown.

25. **Alophoixus phaeocephalus phaeocephalus** (Hartl.).
Criniger phaeocephalus VORDERM., p. 480.
1 sex inc. Wing 95 mm.

26. **Pycnonotus plumosus** Blyth, subsp. VORDERM., p. 475.
1 sex inc. Wing 82 mm.
The Banka bird probably belongs to the typical form with red irides.

27. **Pycnonotus erythropthalmos** Hume, subsp.
Pycnonotus pusillus VORDERM., p. 476.
1 sex inc. Wing 72 mm.
In bad condition: probably, like Sumatran birds, belonging to the typical form (syn. *cynachrus* OBERH., Sumatra).

28. **Pellorneum capistratum nigrocapitatum** (Eyton).
Drymocataphus nigricapittatus VORDERM., p. 485.
1 sex inc. Wing 72 mm.
The Banka bird has been distinguished as *P. c. nyctilampis* (OBERH., Smithsonian Misc. Collections, 74, No. 2, 1922, p. 18): upper parts darker and duller than the typical race. This specimen cannot now be separated from the latter.

29. **Aethostoma rostratum** (Blyth) subsp.
Setaria pectoralis VORDERM., p. 488.
1 sex inc. Wing 67 mm.

It is impossible to say if this now much degraded specimen belongs to the typical form which occurs in Sumatra (syn. *buxtoni* TWEEDD.). It has an almost complete band of brown feathers across the breast, but his feature is often present in topotypes though the breast is generally white.

30. **Anuropsis malaccensis** (Hartl.) subsp.
Brachypteryx malaccensis VORDERM., p. 487.
1 sex inc. Wing 67 mm.

This specimen, collected in 1888, is now very like the Sarawak race, *A. m. saturata* ROB. & KLOSS, on account of the dark sides of the head and deep tawny sides and flanks. It is perhaps *A. m. docima* OBERH., of the adjacent island of Banka (Smithsonian Misc. Coll., 72, No. 2, 1922, p. 10) which, in addition to the above characters, has the upper parts dark slaty brown rather than rufescent.

31. **Cyanoderma erythroptera (?) apega** Oberh.
OBERH., Smithsonian Misc. Collections, 74, No. 2, 1922, p. 8, Banka Id.
Cyanoderma erythropterum VORDERM., p. 483.
3 sex inc. Wings 56, 57, 58 mm.

These skins, though in bad condition, seem to agree with the description of the Banka bird:- small, crown nearly all plain slate colour, upper parts bright ferruginous.

In these respects they are closely resembled by *C. e. rufa* CHASEN and KLOSS, of the south coast of Borneo, which, however, is larger with more grey on the nape.

32. **Turdus obscurus obscurus** (Gm.).
2 ♀. Wings 117, 121 mm.

33. **Orthotomus atrogularis atrogularis** Temm.
Orthotomus flavoviridis VORDERM., p. 494.
1 ♂. Wing 48 mm.

OBERHOLSER has named the bird of Banka *O. a. eumelas* (Smithsonian Misc. Collns., 76, No. 6, 1923, p. 6) and suggests that Sumatran birds may be the same. I cannot see any differences between them and examples of the typical race.

34. **Chalcostetha calcostetha calcostetha** (Jard.).
Chalcostetha insignis VORDERM., p. 467.
1 ♂. Wing 62 mm.

35. **Aethopyga siparaja siparaja** (Raffles).
Aethopyga siparaja VORDERM., p. 466.
1 ♂. Wing 51 mm.

36. **Lepotocoma brasiliana brasiliana** (Gm.).
Nectarophila hasselti VORDERM., p. 466.
1 ♂. Wing 51 mm.

37. **Dicaeum trigonostigma** (Scop.). VORDERM., p. 465.
3 ♂, 1 ♀. Wings ♂ 47, 48, 49; ♀ 48 mm.

38. **Prionochilus percussus ignicapillus** (Eyton).
Prionochilus percussus VORDERM., p. 461.
1 ♂, 1 ♀. Wings ♂ 54; ♀ 50 mm.

39. **Prionochilus maculatus maculatus** (Temm.). VORDERM., p. 464.
1 ♂, 1 ♀. Wings ♂ 49; ♀ 47 mm.

40. **Prionochilus thoracicus** (Temm.). VORDERM., p. 461.
2 ♂. Wings 57, 63 mm.
Known from Borneo (type locality) and the Malay Peninsula. VORDERMANN includes Sumatra in the distribution, but I have not found any definite records.

41. **Chalcoparia singalensis sumatrana** Kloss.
Chalcoparia singalensis VORDERM., p. 469.
1 ♂. Wing 57 mm.
Apparently not differing from Sumatran birds.

AN ACCOUNT OF THE SUMATRAN BIRDS IN THE ZOOLOGICAL MUSEUM, BUITENZORG, WITH DESCRIPTIONS OF NINE NEW RACES.

By

C. BODEN KLOSS,

(Director of Museums, S.S. and F.M.S.)

(With 2 plates).

Though large collections of birds from other parts of Sumatra had been examined and written about by my late colleague H. C. ROBINSON and by myself [1]), I had seen no extensive material from the extreme north and south parts of the island [2]) and I was very pleased therefore, when after returning the Bornean birds belonging to the Zoological Museum, Buitenzorg (my account of which appears in Treubia, XII, 1930, pp. 395—424), Dr. K. W. DAMMERMAN, the Director of that institution, sent me for determination the Sumatran birds in his charge, for many of them were obtained in the Achenese, Lampong and Palembang Districts.

Several papers dealing with South Sumatran birds have been published in the last fifty years [3]) but the most recent is practically thirty years old,

[1]) vide:

I. H. C. ROBINSON and C. BODEN KLOSS, Results of an Expedition to Korinchi Peak, 12,400 ft, Sumatra: Birds. Journ. Fed. Malay States Mus. VIII, Part II, Vertebrates, pp. 81—284, Plates IV—VII, (1918); pp. 319—362 (1923).

II. H. C. ROBINSON and C. BODEN KLOSS, On a collection of Birds from Northeast Sumatra made by Mr. A. C. F. A. VAN HEYST, Journ. Straits Branch, Royal Asiatic Soc. No. 80, pp. 73—133 & map (1919); No. 81, pp. 79—115 (1920).

III. H. C. ROBINSON and C. BODEN KLOSS, On a large collection of Birds chiefly from West Sumatra made by Mr. E. JACOBSON. Journ. Fed. Malay States Mus. XI, pp. 189—340, Plates VI—XI, 3 maps (1924).

[2]) Mr. EDWARD JACOBSON's collections included material from Mt. Dempu (camps between 900 and 2400 metres) on the Palembang-Benkoelen Boundary and a series of skins from the vicinity of Benkoelen Town on the south-western coast.

[3]) I. MARQUIS of TWEEDALE. On a collection of Birds made by Mr. E. C. BUXTON in the District of Lampong, S. E. Sumatra. Ibis, 1877, pp. 283—323, pls. V, VI.

II. A. G. VORDERMAN. Bijdrage tot de Ornithologie van Sumatra. Natuurk. Tijds. v. Ned. Ind. XLI, 1881, pp. 125—129.

III. F. NICHOLSON. On collections of Birds made by Mr. H. O. Forbes in South-eastern Sumatra. Ibis, 1882, pp. 51—65.

IV. F. NICHOLSON. On a second collection of Birds made in the Island of Sumatra by Mr. H. O. Forbes. Op. cit., 1883, pp. 239—257, Plate X.

V. A. G. VORDERMAN. Tweede Bijdrage tot de kennis der Ornithologie van Sumatra, op. cit. XLIX, 1890, pp. 38—70.

VI. A. G. VORDERMAN. Over eene Collectie Vogels afkomstig van de Lampong (Zuid-Sumatra), op. cit. LI, 1891, pp. 210—249.

VII. A. G. VORDERMAN. Lampong-Vogels II. op. cit., LV, 1895, pp. 137—156.

VIII. WITMER STONE. On a collection of Birds from Sumatra obtained by ALFRED C. HARRISON, Jr., and Dr. H. M. HILLER. Proc. Acad. Nat. Sci. Phil., LIV, 1902, pp. 670—691.

IX. C. PARROT. Beitrage zur Ornithologie Sumatras und der Insel Banka. Abhandl. der K. Bayer. Akad. Wiss. II. Kl. XXIV, Bd. 1 Abt. 1907, pp. 151—286.

for PARROT's account of Sumatran birds includes only a few obtained apparently in the South.

The largest of the present collections was made at Wai Lima in the Lampongs during 1921 by Mr. H. C. SIEBERS, until lately Ornithologist of the Buitenzorg Museum. The collection made in Palembang by Mr. B. STRASTERS in 1915 is carefully labelled. VORDERMAN's skins, unaccompanied by field-labels, are merely marked "Palembang" and I do not know whether this refers to the district or to the town. Many of the older specimens are unsatisfactory in that it has not been possible to trace with absolute certainty the obscure localities given on their labels such as Kajoe Agoeng, Peloempang, Loboek Karet, Boekit Gadang. There are several mountains of the last name in Sumatra.

The most recent of the material before me was obtained by Dr. DAMMERMAN's Javanese collector, MADSOED, in Acheen in 1930. A comparison of it with the material from the Lampongs and Palembang has been most interesting: the greater part of the northern collection, however, came from the mountains while the southern material is mostly from the lowlands.

I have often found considerable colour differences between certain of the Achenese skins obtained last year and those collected in Central and South Sumatra twenty to forty years ago, but I have regarded this difference as due in great part to postmortem changes in the older examples.

Acheen has been little explored zoologically and literature on its birds is not extensive. [4])

Part of the Achinese material comes from low localities on, or near, the eastern part of the north coast of Acheen. (Lho Seumawe, Blangkolam, Aloer Poerba, Pantong Laboe, Rampah); but most of it is from higher collecting stations between Bireuen, near the centre of the north coast, and Lake Takengon (Laut Tawar), about 70 kilometres inland. This lake, situated at a height of twelve or thirteen hundred metres among mountains, lies in the only region of Malaysia where pine-trees (*Pinus merkusii*) occur. Isaq, 1000 metres, is about 15 kilometres directly south of Lake Takengon and Pajatoeng Kalan (Pangmoh) 2000 metres, is south of Isaq.

Sumatra is after Borneo the largest island in Malaysia. It stretches from

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4) I. A. O. HUME. Acheen (Birds collected by W. DAVISON) Stray Feathers, I, 1873, pp. 441—463.

II. C. W. RICHMOND. Birds collected by Dr. W. L. ABBOTT on the coast and islands of Northwest Sumatra. Proc. U. S. Nat. Mus., XXVI, 1903, pp. 485—524.

III. F. C. VAN HEURN and R. C. E. G. J. BARON SNOUCKAERT VAN SCHAUBURG. Avifaunistische Studien in de Gajo-landen. Club van Nederl. Vogelk. Jaarber. No. 11, 1921, pp. 4—19.

IV. F. C. VAN HEURN. Over een collectie Vogelhuiden van Oost-Atjeh. op. cit. supra., No. 12, 1922, pp. 65—83.

V. R. SNOUCKAERT VAN SCHAUBURG. On a collection of Birds from Acheen. Ibis 1922, pp. 662—675 (Practically a reprint of III & IV in English).

The following paper deals with a small collection from a locality a little south of those whence came the North-east Sumatran collections discussed by Messrs ROBINSON and KLOSS: the area is continuous with the south-east of Acheen:

A. C. F. A. VAN HEYST and R. SNOUCKAERT VAN SCHAUBURG. Aanteekeningen omtrent de avifauna van de Karohoogvlakte tusschen Seriboe Dolok en het Toba-Meer. Club. v. Nederl. Vogelk., Jaarber. No. 10, 1920, pp. 50—59.

Lat. 5° 4′ North to 5° 59′ South, lying across the equator at an angle of about 45 degrees. From end to end runs the Barisan range of mountains, of which Korinchi Peak (or Mt. Indrapura) has a height of 3806 metres (12487 feet). It is the second loftiest summit in the subregion.

The only important depression in the Barisan Range occurs in the neighbourhood of Padang Sidempuan (Lat. 1° 30′ N). North of this locality the range is broader than to the south though the island is considerably narrower. A less marked interruption exists inland from Benkoelen (Lat. 4° 15′ S.).

On either side of the mountains are low-lying plains, far broader on the east than on the west. The greatest breadth of Sumatra, at right angles to its axis and slightly south of the equator, is about 4½ degrees.

Such a great island, stretching through so many degrees of latitude and actually longer than the Malay Peninsula, has naturally evolved a number of geographical races. I do not propose to analyse the local zoological differences — best shown perhaps by the mammals and birds at present — but the Padang Sidempuan depression does appear to be the boundary of a number of local forms confined to the northern part of the island. Thus the orang utan is only known to the north of 1° 30′ N. and subspecies of several tupaias and squirrels have the same restricted habitat. Of birds several races seem to be confined in Sumatra to this northern area: amongst them are the following forms represented by others in the centre and south:— *Arborophila orientalis rolli, Treron curvirostra* (?) *harterti, Treron vernans parva, Streptopelia chinensis* (?) *minor, Serilophus lunatus rothschildi, Pycnonotus bimaculatus snouckaerti, Stachyris poliocephala pulla, Thringorhina striolata umbrosa, Cyanoderma erythroptera pyrrophaea, Cettia montana sepiaria* and *Munia atricapilla batakensis.*

In the south there seems to be a small infiltration of Javanese forms.

As the result of the examination of this material I have proposed seven new races of Sumatran birds and have named Javanese representatives of *Pitta sordida* and *Aethostoma pyrrogenys.* The presence of *Phylloscopus occipitalis* (subsp. *coronatus*) in Sumatra does not appear to have been recorded before. Several other known races have been added to the fauna of the island.

Systematic.

Treron vernans parva subsp. nov. N. E. Sumatra.
Pitta sordida sumatrana subsp. nov. S. Sumatra.
Pitta sordida javana subsp. nov. West Java.
Aethostoma pyrrogenys besuki subsp. nov. East Java.
Stachyris poliocephala pulla subsp. nov. N. E. Sumatra.
Cettia montana sepiaria subsp. nov. N. Sumatra.
Munia punctulata fretensis subsp. nov. Malay Peninsula and Sumatra.
Zosterops aureiventer sumatrana subsp. nov. Sumatra.
Zosterops chlorates korinchi subsp. nov. Sumatra.

PHASIANIDAE.

Rhizothera longirostris longirostris (Temm.).

1 sex. inc., Fort van der Capellen, Sumatra's Westkust, 500—750 metres. (OUWENS coll.).

Wing 193 mm. (worn).

Arborophila rubrirostris (Salv.).

1 ♂, Sungei Kumbang, Korinchi, 1350 metres. (ROBINSON and KLOSS coll.).

1 ♀, Korinchi Valley, 900 metres. (ROBINSON & KLOSS coll.).

1 ♂, Pajatoeng Kalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 140, 144: ♀ 133 mm.

This partridge shows considerable variation in the amount of white on the crown and nape; in the black banding of the upper parts, the ground-colour of which is also somewhat variable; and in the colour of the throat and foreneck which varies from entirely white, as in the juvenile, to entirely black except for the chin. The ear-coverts vary from white with a black spot to the reverse, and the lores also.

Arborophila orientalis sumatrana O.-GRANT.

1 ♀, Pagar alam, Palembang, 500—750 metres.

1 ♀, Sumatra.

Wings 133, 137 mm.

As with the typical Javanese form this race also is very variable in the colour of the crown (brown tipped with black to black), black barring on the upper parts, variations in the amounts of black and white on the foreneck and amount of white on the abdomen.

Arborophila orientalis rolli (ROTHS.). Plate 3.

Arboricola rolli ROTHSCHILD, Bull. B.O.C. XXV, 1907, p. 7 (Sibajak near Brastagi, *) N. E. Sumatra); ROBINSON and KLOSS, Journ. Straits Branch Royal Asiatic Soc., No. 80, 1919, p. 74 (Bandar Baroe and Tengkeh, Simeloengen near Brastagi); VAN HEYST and SNOUCKAERT, Club v. Ned. Vogelk., Jaarb. No. 10, 1920, p. 52 (Singgalang, near Brastagi).

1 ♂, Redelong, Acheen, 1300 metres. 24 July 1930.

Bill black, orbital skin red, feet apparently pink or red (from dried skin).

Wing 145 mm, tarsus 45 mm.

This is apparently the fourth known adult specimen of this bird. I regard it as the representative in the northern mountains of Sumatra of *A. o. sumatrana* which is found in the centre and south.

As with the other subspecies the colours of the head and foreneck are evidently somewhat variable, but the present example agrees with ROBINSON and KLOSS' description of their adult male. The type was said to have the

*) Brastagi, now a well-known hill-station, is in the Battak Mountains not far from the north end of Lake Toba.

Arborophila orientalis campbelli, ♀ (Left) ; *A. o. rolli*, ♂ (Right)

throat rusty olive-brown, but that colour is found on the breast and this character easily distinguishes *rolli* from *sumatrana* (vide plate 3). The black bill and absence of white spots on crown and nape separate it from the red-billed *A. rubrirostris*.

The few specimens of this mountain partridge previously secured were all taken near the north end of Lake Toba so the present example extends the range by more than 150 miles.

The soft parts of the bird from Singgalang are given as:— feet, flesh-coloured; iris dark brown; bill black with orange-brown tip.

I have shown with this bird a figure of *A. o. campbelli* (Robinson) which is its representative in the Malay Peninsula. Coloured figures of the other Sumatran subspecies *A. o. sumatrana* (O. Grant) and of the East Javanese form *A. o. orientalis* (Horsfield) are given in Journ. Fed. Malay States Mus. XI, 1924, plate VII.

Caloperdix oculea sumatrana O.-Grant.

2 ♂, 1 ♀, Kajoetanam, Sumatra's Westkust. (Ouwens coll.).

1 ♀, Sawah loento, Sumatra's Westkust, 500 metres (Rappard coll.).

1 ♂, Sumatra.

1 sex. inc., Komering ilir, Palembang.

1 sex inc., Sumatra.

Wings ♂ 134, 138, 140: ? 138, 147: ♀ 135 mm.

A good deal of variation is shown as regards the colour of the pale bars on mantle and sides of body, and in the presense or absence of black bars on breast and abdomen.

Rollulus roulroul (Scop.).

1 ♂, Palembang.

1 ♂, Komering ilir, Palembang.

1 ♂, Aloer Poerba, Acheen.

Wings 138, 141, 143 mm.

Excalfactoria chinensis subsp.

1 ♂, Lampongs,

1 ♂, Sumatra.

1 ♂, Medan, N. E. Sumatra.

Wings 68, 69, 72 mm.

The males of this species are very variable but these specimens seem to be within the range of variation of a Malayan series. The only difference between the specimen from the Lampongs and that from Medan is that the former has rufous in the wing whereas there is none in the wing of the latter. The bird labelled "Sumatra" has the chestnut area of the underside much more extensive than the others. These individual differences are found in Malayan birds, *E. c. chinensis*.

Birds from South and West Sumatra have been determined as *E. c. lineata,* the Philippine form, the female of which is more heavily barred and darker than the continental one: and ROBINSON and KLOSS therefore included *E. c. palmeri* RILEY, a name given to Javanese birds, in their Sumatran List.

Houppifer erythropthalmus erythropthalmus (RAFFLES).

1 ♀, Talangbetoetoe, Palembang (KREHT coll.).

Wing 220 mm.

Houppifer inornatus SALV.

1 ♀, Palembang.

Wing 213 mm.

The female, which is chestnut with pale centres to the feathers, was first fully described and figured in Journ. Fed. Malay States Mus., VIII, part 2, 1918, p. 101, pl. IV.

Lophura ignita sumatrana (DUBOIS).

Euplocamus sumatranus DUBOIS, Bull. Ac. Belg. (2) XLVII, 1879, p. 825 (Palembang, South Sumatra); VORDERMAN, Nat. Tijd. Ned. Ind. XLIX, 1890, pp. 97—101.

Lophura sumatrana BÜTTIKOFER, Notes Leyden Mus., XVII, 1896, pp. 177—181.

1 ♀, Komering ilir, Palembang *).

Wing 246 mm.

A bird of very bright rufous colour only faintly vermiculated and only slightly patched with rufous on the foreneck and breast. Tail chestnut.

GHIGI has recently dealt with the Crested Fireback Pheasants of Sumatra in a paper in which he recognises four forms in the island, two of which are named by himself (Rev. d'Hist. Nat. App., L'Oiseaux, VII, 1926, pp. 48—52 and plate).

His views are weakened by two incorrect premises:— (I) that BÜTTIKOFER was the first to name *L. sumatrana* on an example in the Leyden Museum: (II) that the so-called *rufa* of Sumatra is not the typical *rufa,* because Sumatra is not inhabited by the true *rufa. Sumatrana* was described by DUBOIS and the type, a male, is in the Royal Natural History Museum at Brussels: BÜTTIKOFER, who discussed the genus *Lophura,* stated that there were two males in Leyden in every respect similar to the type in Brussels which he had examined. *Rufa* is based on a Sumatran female described by RAFFLES (*Phasianus rufus* Trans. Linn. Soc., XIII, 1822, p. 321. Undoubtedly from the West Coast of Sumatra: either Benkoelen or Padang) and this author also described the male under *Phasianus ignitus* LATHAM. (The female described by RAFFLES under this name is not a *Lophura,* but probably the female of *Acomus inornatus* SALV.).

I do not find GHIGI's treatment convincing and judging from the material I have seen and information given by live animal dealers am still strongly

*) The provenance of this female is the same as that of one of the two males in Leyden which BÜTTIKOFER definitely determined as *sumatrana* (l.c.s., p. 179).

inclined to believe that only two Crested Fireback Pheasants inhabit the island, the greater part of which is occupied by *L. rufa* (RAFFLES), syn. *Euplocamus vieilloti* G. R. GRAY, Malay Peninsula: while in the south (perhaps confined to Palembang and the Lampongs) occurs *L. ignita sumatrana* (DUBOIS). The presence of white central tail-feathers in the males of the latter is probably a local aberration as I am informed that the tails of living males imported into Singapore from Palembang do not differ in any way from those of the well-known Bornean bird *L. ignita ignita* (S. & N.), syn. *Euplocamus nobilis* SCLATER. Apart from other differences the South Sumatran bird is distinguished by its very bright female; in colour above between Sanford's brown (Ridgway) and burnt sienna; by its tail coloured between chestnut and bay, and by the faintness of the dark vermiculations which are absent on head, neck, mantle and tail. (These are the characters of the female listed above).

In both Sumatran species there is no doubt individual variation and variation due to age, as in the two species occupying respectively the Malay Peninsula and Borneo where no hybridisation can occur. If in Sumatra there are two true species — a black-bellied one with white flank markings and white tail-feathers (*rufa*), and a red-bellied one with fulvous tail-feathers (*ignita*) — interbreeding in the area common to both would, combined with the variations, produce the individuals which seem to suggest the existence of several forms.

Lophura sumatrana albipennis, the more northern form proposed by GHIGI, seems to be either the northern *rufa*, or a hybrid inheriting marked *rufa*-like characters: *L. sumatrana delacouri*, GHIGI's southern form, is the southern *ignita sumatrana*, or a hybrid in which the feature of that subspecies are dominant.

GHIGI's type localities are unfortunately conjectural: he suggests that *albipennis* occurs in Sumatra opposite the Malay Peninsula, *delacouri* in the south of the island — that is to say that *albipennis* is found in the habitat of *rufa*, which it resembles: and *delacouri* in the region of *sumatrana* to which it seems very similar.

In Borneo occurs one species only: the Malay Peninsula is occupied by another, different, species only: in neither area have these solitary species developed into two forms. In Sumatra both species occur: and there no reason to believe that they are less naturally stable there than elsewhere. I believe that the additional so-called forms occurring in Sumatra are merely the result of hybridisation where the two species meet or overlap in the south.

Gallus gallus bankiva TEMM.

Gallus gallus robinsoni ROTHS., vide KLOSS, Ibis, 1931, p. 322.

1 ♀, Sawah loento, Sumatra's Westkust, 500 metres (RAPPARD coll.).

Wing 188 mm.

The typical form occurs in North Sumatra: from it the Javanese race differs in that the male has the mantle darker, its feathers less lanceolate and the dark centres, when present, broader and more truncate. The pattern of the mantle differs in the same way in females.

Polyplectron chalcurum LESS.

1 ♂, 1 ♀, Palembang.

Wings ♂ 178: ♀ 154 mm.

Argusianus argus argus (LINN.).

2 ♂, Banjoeasin, Palembang.

Wings 680, 790 mm.

TURNICIDAE.

Turnix suscitator suscitator (GM.).

Turnix pugnax and *javanicus* auct.

1 ♂, Palembang.

2 ♀ ad., 1 ♀ juv., Medan, N. E. Sumatra.

Wings ♂ 80: ♀ 86, 87 mm.

The male agrees more nearly with the Javanese than with Malayan males in having the black bars on the breast very pronounced and extensive and in being more rufous above.

I have no Javanese females, but the Medan females differ from Malayan females in having the black of the foreneck less extensive; in being less rufous below; in having the pale areas of the wings whiter, less buffy; and in having more rufous markings above which tend to form a collar. Females from Central Sumatra are also rufous above, and less black on the foreneck than Malayan examples. They do not, therefore, bear out the statement of ROBINSON and BAKER (Bull. B.O.C. XLVIII, 1928, p. 60) that while the typical race occurs in the south of Sumatra, the north of the island is inhabited by the Malayan form (*atrogularis* EYTON) [1]).

The juvenile is paler and browner than the adults.

The character of general rufescence is of doubtful value and seems due in a great degree to postmortem changes. A recently collected series of Malayan birds is much greyer than another which was collected some years ago: but in the latter there is, nevertheless, no trace of the rufous collar shown by the Sumatran females.

TRERONIDAE.

Butreron capellei (TEMM.) subsp.?

1 ♂, Lampongs. (VORDERMAN coll.).

1 ♀ ad., 1 ♂ juv., Wai Lima, Lampongs.

1 ♀, Deli, N. E. Sumatra.

Wings ♂ 192, 177 juv.: ♀ 188, 189 mm.

I have seen no typical Javanese specimens which appear to be very scarce: but I cannot separate from each other Malayan birds (*magnirostris* STRICKL.), Bornean (*messophora* OBERH.) and Sumatran (*panochra* OBERH.). My latê colleague, Mr. H. C. ROBINSON, after carefully examining and taking detailed

[1]) STRESEMANN, in his summary of the forms of *T. suscitator* found in the Malay Archipelago records only the typical race in Sumatra (Mitt. Zool. Mus. Berlin XV, 1930, p. 645).

measurements of forty-five specimens from the above three localities in the British Museum was of the same opinion. Non-Javanese birds may, as a whole, differ from the typical form which, Schlegel has remarked, has a small bill: if so, they should stand as *B. c. magnirostris*.

Robinson found that one female from the Lampongs had the exposed culmen short, viz., 19.2 mm (the same measurement for the Wai Lima female is 21.2 mm) and he remarked that a few Javanese races extends to the Lampongs but that females from Palembang had the exposed culmen over 24 mm. I consider the measurement an unreliable one as the feathering of the maxilla is very variable. The exposed culmens of the Lampongs male and Deli female both measure 24 mm.

Sphenurus oxyurus (Temm.).

1 ♀, Rimbau pandjang, Sumatra's Westkust (Ouwens coll.).

1 ♂, Korinchi Valley, 800 metres (Robinson & Kloss coll.).

Wings ♂ 160: ♀ 150 mm.

Treron curvirostra curvirostra (Gm.).

1 ♂, 1 ♀, Wai Lima, Lampongs.

Wings ♂ 132: ♀ 130 mm.

Inseparable from typical birds from the Malay States.

Parrot has named *harterti* an adult male from Deli, N. E. Sumatra, on account of its small size (wing 123 mm). Typical Malayan have wings ranging from 127 to 138 mm.

An unusually small individual occurs occasionally in most areas of distribution and the type of *harterti* may be abnormal. On the other hand *Trerons vernans* is very small in N. E. Sumatra and it is possible that *curvirostra* is there small also.

Treron nasica Schlegel, though recorded by him from S. W. Sumatra, is based on specimens of *curvirostra* from S. E. Borneo: the type locality is Bandjermasin.

Treron vernans griseicapilla Schlegel.

Dendrophassa vernans abbotti Oberh., Journ. Wash. Acad. Sci., XIV, 1924, p. 298. Trang, Peninsular Siam.

2 ♂, 1 ♀ juv., Wai Lima, Lampongs.

1 ♂, Palembang.

1 ♀, Talang semoet, Palembang.

1 ♀, Blangkolam, Acheen.

Wings ♂ 136, 139, 140: ♀ 134, 138 mm.

This name was proposed very informally by Schlegel (Ned. Tijd. Dierenk., 1, 1863, p. 71) for birds from Sumatra and Banka. I restrict the *terra typica* to southern Sumatra.

The birds we have examined from that half of the island have wings averaging about 140—141 mm in males: and birds from Borneo (other than

the south or south-east) and from the Malay Peninsula agree with them: so do the only West Javan birds I possess (a pair from Cheribon). Examples from East Java, which I regard as *T. v. purpurea* (GM.), have the head and foreneck paler grey in males and paler green in females.

Treron vernans parva subsp. nov.

Osmotreron vernans ROBINSON and KLOSS, Journ. Straits Branch Royal Asiatic Soc., No. 80, 1919, p. 77 (Deli, N. E. Sumatra).

Like *T. v. griseicapilla* SCHLEG., of southern Sumatra, but smaller. Wings ♂ 132—138: ♀ 128—131 mm. Average wing length of males about 134 mm.

Type. Adult male from Deli, N. E. Sumatra. Mus. Buitenzorg, No. 5978. A second example with the same history, No. 5979.

Wings 135, 135 mm.

The wings of a series obtained by Mr. A. C. F. A. VAN HEYST, also from Deli, measured:— ♂ 132, 132, 133, 135, 136, 138: ♀ 128, 129, 131 mm. (R. & K., l.c.s.).

Treron olax (TEMM.).

1 ♂, Katimbang, Lampongs. VORDERMAN coll.).

1 ♀, Aloer Poerba, Acheen.

Wings 125, 126 mm.

PARROT has named a male from Deli *hageni*: paler than the typical form — also from Sumatra; wing 116 mm. Certainly small for a male, but I have seen another from Deli with a wing of 122 mm and regard PARROT's example as a minimum-size individual. I find that the wings of this bird vary from about 117 to 127 mm.

Ptilinopus porphyreus (REINW. in TEMM.).

1 ♀, Sungei Kumbang, Korinchi, Sumatra, 1400 metres (ROBINSON and KLOSS coll.).

Wing 142 mm.

Ptilinopus jambu (GM.).

3 ♂, 1 ♀, Medan, N. E. Sumatra.

Wings ♂ 138, 141, 148: ♀ 134 mm.

The type locality is Sumatra: Malayan and Bornean birds do not differ.

Ducula badia badia (RAFFLES).

1 sex. inc., Lampongs. VORDERMAN coll.).

2 ♂, Palembang.

Wings ♂ 229, 230: ? 230 mm.

Myristicivora bicolor (SCOP.).

1 sex. inc., Benkoelen.

Wing 223 mm.

COLUMBIDAE.

Macropygia unchall unchall (WAGL.).

1 ♀, Fort de Kock, Sumatra's Westkust, 900 metres (GROENEVELD coll.).

Wing 172 mm.

Macropygia phasianella emiliana BP.

Macropygia phasianella barussana SIEBERS, Treubia XI, 1929, p. 152. Palembang.

1 ♂, 1 ♀, Palembang.

Wings ♂ 170: ♀ 161 mm.

I have not seen these specimens since recording them for Sumatra in 1923 (v. ROBINSON and KLOSS, Journ. Fed. Malay States Mus., VIII, part 2, 1923, pp. 323, 355). They are the material on which *barussana* is based. According to SIEBERS the Sumatran bird differs from *emiliana* of Java in lesser size and in the almost complete disappearance of brown on the inner web of the first primary and the much smaller size of the grey patches on the inner webs of the outer tail feathers. Examination of a considerable Javanese series shows that these characters are only individual and that everywhere birds vary considerably: in some the brown border to the primary and the grey patches on the tail feathers have entirely disappeared. Neither are Sumatran birds smaller (wings ♂ 170, ♀ 161 mm): the wings of Javanese birds range ♂♂ 163—180, ♀♀ 160—174 mm.

Macropygia ruficeps sumatrana ROBINSON & KLOSS.

1 ♀ imm., Wai Lima, Lampongs.

1 ♀ imm., Fort de Kock, Sumatra's Westkust, 900 metres.

1 ♂ imm., 1 ♀ imm., Geureudong, Acheen, 900 metres.

Wings ♂ 137: ♀ 136, 136, 137 mm.

PERISTERIDAE.

Streptopelia chinensis tigrina (TEMM.).

1 ♂, Wai Lima, Lampongs.

1 ♂, Palembang.

1 ♀, Rimbau pandjang, Sumatra's Westkust (OUWENS coll.).

1 ♂, Pangkalan Koto Baroe, Sumatra's Westkust (STRASTERS coll.).

Wings ♂ 138 [1]), 144, 147: ♀ 144 mm.

PARROT [2]) has separated as *minor* birds from Deli on account of small size. He places under this name, apparently, his unsexed type from Deli and also three males and one female ? from "Sumatra" with wings of 135—138.5 mm and I have measured three females from Deli with wings 134—138 mm. The race is probably good, though DAVISON got a female in Acheen with a wing

[1]) Sumatra's Westkust (P. K. Baroe).

[2]) Abh. K. BAYER Akad. Wiss, II, Kl. XXIV, Bd. 1 1907, p. 275.

of 141 mm, for as far as I am aware Sumatran birds from south of the equator have wings of about 138—150 mm as have those of Java which is the terra typica of *tigrina*.

Geopelia striata striata (LINN.).

2 ♀, Wai Lima, Lampongs.

Wings 97, 98 mm.

RALLIDAE.

Hypotaenidia striata gularis (HORSF.).

1 sex inc., Benkoelen (VORDERMAN coll.).

2 ♀, Medan, N. E. Sumatra.

Wings ♀ 111, 118: ? 110 mm.

Sumatran and Malayan birds do not differ from Javanese. Bornean birds are darker beneath and are probably referable to the typical Philippine form.

Poliolimnas cinereus cinereus (VIEILL.).

1 ♂ imm., Takengon, Acheen, 1200 metres.

Wing 98 mm.

An immature bird with the crown brown and no dark patch in front of the eye.

Amaurornis phoenicura javanica (HORSF.).

1 ♀, Fort van der Capellen, Sumatra's Westkust, 500—750 metres. (GROENEVELD coll.).

1 ♀, Sitangkai, Sumatra's Westkust. (GROENEVELD coll.).

1 ♀, Medan, N. E. Sumatra.

Wings 138, 142, 152 mm.

Birds from Java, Borneo and its islands and Singapore, which we regard as *A. p. javanica*, are as a series greyer, less olivaceous above than those from the Malay Peninsula and Siam which appear to be *A. p. chinensis* (BODD). Their wings also run considerably smaller:— ♂ 138—160, ♀ 132—152 mm, against, in continental birds, ♂ 159—180, ♀ 148—164 mm.

It is practically certain, however, that *A. p. chinensis* (BODD) occasionally visits Sumatra as ROBINSON and KLOSS have recorded a bird from Korinchi with a wing of 170 mm and RILEY a male from East Sumatra with a wing of 175 mm.

Gallinula chloropus orientalis HORSF.

1 ♀, Takengon, Acheen, 1200 metres.

Wing 165 mm.

CHARADRIIDAE.

Charadrius leschenaulti LESS.

1 sex inc., Benkoelen.

Wing 144; bill from gape 26 mm.

Tringa hypoleucos LINN.

1 ♂, 2 ♀, Wai Lima, Lampongs.

2 ♂, Palembang.

Wings ♂ 104, 108, 102: ♀ 105, 108 mm.

Rhyacophilus glareola (GM.).

1 ♂, 1 ♀, Palembang.

Wings ♂ 124: ♀ 121 mm.

Limonites minuta ruficollis (PALL.).

1 ♂, Telok Betong, Lampongs.

Wing 101 mm.

Capella stenura (KUHL).

1 ♂, Palembang.

1 sex inc., Palembang.

Wings ♂ 123: ? 130 mm.

CICONIIDAE.

Pseudotantalus cinereus (RAFFLES).

1 sex inc., Fort de Kock, Sumatra's Westkust, 900 metres.

Wing 465 mm.

ARDEIDAE.

Bubulcus ibis coromandus (BODD.).

1 ♂, Pajokomboe, Sumatra's Westkust (STRASTERS coll.).

1 ♀, Kajoe agoeng, Palembang, (OUWENS coll.).

Wings ♂ 250: ♀ 234 mm.

Ixobrychus eurythmus (SWINH.).

Nannocnus eurythmus ROB. & KLOSS, Journ. Fed. Malay States Mus., VIII, Part 2, 1923, pp. 328, 357

Ixobrychus eurhythmus KLOSS, Treubia, XII, 1930, p. 399.

1 ♂, Palembang.

1 sex inc., Kajoe agoeng, Palembang (OUWENS coll.).

Wing ♂ 145: ? 135 mm.

This bird is now known in Malaysia from the Malay Peninsula, Sumatra, Java, Pulo Mata Siri in the eastern Java Sea, and Borneo.

ANATIDAE.

Dendrocycna javanica javanica (HORSF.).

1 ♀, Palembang.

2 ♂, Kajoe agoeng, Palembang (OUWENS coll.).

Wings ♂ 195, 197: ? 192 mm.

FALCONIDAE.

Lophospizias trivirgatus trivirgatus (TEMM.).

1 ♀ (sexed ♂), Rimbau pandjang, Sumatra's Westkust. (OUWENS coll.).

Wing 230 mm.

Astur soloensis (HORSF.).

5 ♂, 3 ♀, Wai Lima, Lampongs.

1 ♂, Pagaralam, Palembang, 500—750 metres.

1 ♂, Palembang.

1 ♂, Pajokomboe, Sumatra's Westkust.

Wings ♂ 178, 181, 181, 182, 187, 187, 187: ♀ 196, 199 mm.

BARTELS and STRESEMANN treat *soloensis* as a race of *Astur badius.* The latter, represented by *A. b. poliopsis,* may be a resident, whereas *soloensis* certainly breeds in China and migrates to the Malaysian and Austro-Oriental subregions in winter.

Astur badius poliopsis besides being a considerably larger bird is much paler above and the adults are always banded brown and white below instead of being generally uniform cinnamon rufous on the breast as in *soloensis.* The cere of *badius* turns black in dry skins, in *soloensis* it remains yellow. I think the colour of the cere is a species, not a racial, difference. Further, if *soloensis* were a form of *badius* we should expect it to be larger than the tropical *poliopsis,* but the contrary is the case.

Spilornis cheela malayensis SWANN.

1 ♂, Aoer, Lahat, Palembang (STRASTERS coll.).

1 sex inc., Palembang.

Wing ♂ 365: ? 348 mm.

Elanus caeruleus hypoleucos GOULD.

2 ♂, Palembang.

Wings 285, 285 mm.

Machaeramphus alcinus WESTERM.

1 sex inc., Pajokomboe, Padangsche Bovenlanden (VAN DER PLAS coll.).

1 sex inc., Padangsche Bovenlanden (VAN DER PLAS coll.).

Wing 365, 370 mm.

Pernis apivorous japonicus KURODA.

2 ♀, Wai Lima, Lampongs. November 1921.

Wings 415, 415 mm.

Rather pale birds without any indication of a crest. Feathers of the nape lanceolate. The dark bars on the tail are narrow and indistinct and the interspaces are much lineated, i.e., the examples are immature.

In 1922 STRESEMANN stated that the large Siberian race, *P. a. orientalis* TACZ., wintered in the Sunda Islands and, more or less following him, we have

ourselves recorded under that name crestless females with wings of 450 mm from Sumatra (February) and the Anamba Islands (October). Upon reconsideration, however, and on re-examination of a considerable series of birds collected in the Malay Peninsula (from Tenasserim to Singapore), Sumatra and Borneo I am inclined to think that the presence in Malaysia of this North Asiatic Continental form is doubtful.

The two large females mentioned above agree closely (except for size) with two crestless males from Kuala Lumpur and Singapore with wings of 408 mm. These four birds are dark brown throughout, blackish on the sides and front of the neck; the dark bars on the tail are narrow and the paler interspaces lineated: but in any series the variation in colour (probably to a large degree due to age) is enormous and no two birds are exactly alike [1]).

SWANN gives for wing lengths of *orientalis*, male 450, female 475 mm, BAKER gives 483 mm, thus markedly larger than any individual known to me from Malaysia. KURODA, however, has recently separated crestless birds breeding in Japan from *orientalis* on account of smaller size [2]): his *P. a. japonicus* has the wings of males 402—432, females 430—447. Adults have "the middle throat always with a distinct longitudinal blackish mark continuing to a black band, extending round the lower throat, thus making a w-shaped black mark." This mark, however, frequently occurs in Malaysian birds, both crested and crestless. The latter agree well in size with KURODA's measurements.

Only ten out of the thirty-four birds before me have a distinct nuchal crest (oi long black feathers with rounded ends, generally tipped with buff) and judging by the tail patterns these are all practically adult. The rest of the series, composed of adult, sub-adult and immature individuals, have no crest. It would perhaps be unreasonable to expect to find a crest present in all individuals that develop it — stage of plumage and condition of moult should be taken into consideration.

However, in the Jaarbericht v. d. Club v. Nederl. Vogelk., No. 13, 1923, p. 145, VAN HEURN quotes BARTEL's opinion that the feathers of the nape are broad and rounded in *ptilorhyncus* [3]), but small and lanceolate in *orientalis* (vide VAN HEURN's plate III) [4]) and concludes that the difficulty regarding the determination of HONEY-BUZZARDS found in Malaysia is thus solved.

The above is the case respectively (a) when a full crest is present, and (b) when there is no crest. It may still be, however, that the rounded nuchal feathers only appear with the moult that produces the full crest, but if BARTELS is correct the curious state of affairs is found that the crestless visiting (?) form seems to be met with in Malaysia in far greater numbers than the crested resident (?) race: for the crestless birds, if migrants, are

[1]) BAKER in Fauna Brit. Ind. Birds, V, 1928, p. 165, has some interesting remarks on stages of plumage of some Indian Honey-Buzzards.

[2]) Dobuts. Zasshi, 37, 1925, p. 226 (English Version) Hondo, Japan: also Formosa and China.

[3]) As indeed they are figured by TEMMINCK (Pl. Col. 44, 1823).

[4]) See also the immature female figured by SCHLEGEL and MÜLLER as *Falco (Pernis) ptilonorhynchus* in TEMMINCK's Verh. Nat. Gesch., Aves, pl. 7 (1839—44).

apparently the Japanese form *japonicus* since they are not large enough to be determined as *orientalis*.

The wing lengths of the crested birds are:— males 387, 392, 395, 405, 416, 416, 418, 427, 432: female 422 mm.

The crestless birds measure:— males 400—438: females (408 once) 415—442 (450 twice): they were all taken between September and March while the crested individuals were met with through the summer as well.

For the present I use *japonicus* for the crestless Honey-Buzzard found in Malaysia [5]) though *Pernis maculosa* LESSON, from Bengal, is apparently uncrested. BAKER states that Celebean birds cannot be separated from *ptilorhyncus*, but they appear to range considerably smaller than those of Malaysia: wings 360—395 mm (vide GURNEY, Ibis, 1880, p. 217). Both crestless and crested birds are found in the island (again, vide GURNEY, l.c.s.), but, among recent authors, SWANN and MATHEWS treat both as one form of a distinct species, *P. celebensis celebensis* WALLACE.

All birds taken in the Philippines appear to be crested, and on this account SCLATER has separated them from Celebean birds, as *P. celebensis steerei* because of their crests. The examples seen by him varied in wing-length from 345 mm (♂ Samar. Worn), and 364 mm (♂ Negros. Type), to 390 mm (sex. inc., Luzon). MC GREGOR gives 390 and 395 mm for a male and female from Mindoro; GURNEY 395 for a female from Mindanao and 407 and 422 mm for unsexed Philippine birds. Though some of these are as large as *ptilorhyncus*, the average appears to be smaller.

Pernis torquata LESSON, is a crested individual from Sumatra.

I cannot recognise more than one species of *Pernis*, but BARTELS and STRESEMANN maintain *ptilorhyncus* as a second on account of differences between its eggs and those of *apivorous*. The various forms fall into two sections:— the northern crestless, the southern crested: but in the latter the farther north the birds are found the smaller the crests become. Indian birds (*ruficollis* LESS., Bengal) have the crest much less developed than in *ptilorhyncus* (fide BAKER): and of South Chinese birds LA TOUCHE records a female from Foochow with "a small, but well-defined crest" and states that the short-crested Indian and Chinese form is a very different bird from the long-crested island form (Ibis, 1913, p. 279).

The crest is a local character and its presence and state of development together with the size of the birds are the principal features of mere geographical races of *apivorous*.

It seems we may admit for the present:—

P. a. apivorous	
P. a. orientalis	Northern: crestless.
P. a. japonicus	

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[5]) BARTELS, quoted by VAN HEURN, l.c.s., states that it occurs in Java as a non-breeding visitor.

P. a. ruficollis
P. a. ptilorhyncus } Southern: crested.
P. a. steerei
P. a. celebensis Southern: ? crestless.

Spizaetus cirrhatus limnaetus (HORSF.).
1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).
1 sex inc., Palembang.
Wings ♂ 400: ? 388 mm.

Spizaetus nipalensis alboniger (BLYTH).
2 adults sex inc., Sumatra. (VAN DER PLAS col.).
Wings 343, 370 mm.

Microhierax fringillarius (DRAP.).
1 ♂, 2 ♀, Wai Lima, Lampongs.
1 ♂, Boemi agoeng, Lampongs.
2 ♀, Talang betoetoe, Palembang.
1 ♂, Palembang.
1 ♀, Kajoe agoeng, Palembang. (OUWENS coll.).
1 ♂, Fort van der Capellen, Sumatra's West Coast, 460 metres.
1 ♂ imm., 1 ♀, Aloer Poerba, Acheen.
Wings ♂ 91, 92, 93, 97, 101: ♀ 97, 97, 97, 99, 100 mm.

It is possible that the two largest birds listed as males are wrongly sexed. In the young bird the forehead, sides of neck and the cheeks are rufous instead of white.

BUBONIDAE. *)

Ketupa ketupu ketupu (HORSF.).
1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).
2 ♀, Rimboe pandjang, Sumatra's Westkust. (OUWENS coll.).
1 sex inc. juv., Sawah loentoe, Sumatra's Westkust, 500 metres. (OUWENS coll.).
Wings ♂ 317: ? 290 juv.: ♀ 315, 333 mm.

Huhua sumatrana sumatrana (RAFFLES).
1 sex inc. ad., 1 sex inc. juv., Manindjau, Sumatra's Westkust, 500 metres.
1 ♀ Isaq, Acheen, 1000 metres.
Wings ? 345, 343 juv.: ♀ 360 mm.

The young bird is largely white barred with fuscous, but is assuming adult plumage on scapulars, wings and tail.

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*) By a *lapsus calami* a specimen of *Glaucidium brodiei* was listed in my recent Bornean paper (Treubia, XII, 1930, p. 400) as *G. b. sylvaticum* (Bp.). It should have been recorded as *G. b. borneense* SHARPE, which is the Bornean race of this owl.

Otus babakkamoena lempiji (HORSF.).

1 sex inc., Lampongs. (VORDERMAN coll.).

Wing 147 mm.

Otus rufescens (HORSF.).

1 ♀, Wai Lima, Lampongs.

Wing 130 mm.

Ninox scutulata malaccensis (EYTON).

Ninox scutulata borneensis PARROT (Sumatra) partim.

1 sex inc., Lampongs. (VORDERMAN coll.).

1 ♀, Talang betoetoe, Palembang.

1 sex inc., 1 ♀ juv., Kajoetanam, Priaman, Sumatra's Westkust. (OUWENS coll.).

Wing ♀ 187: ? 191, 195 mm.

These are the smaller birds with less white on the lower surface which we consider to belong to the above race. In the majority of topotypes the crown is darker, rather greyer, than the back; in others it is concolorous with the back and in such the back is generally rather browner and paler than in the former. These three specimens have brown crowns, but in other Sumatran specimens the crowns are greyish.

A considerable series from the Malay Peninsula, which we regard as *N. s. scutulata* (RAFFLES. Sumatra) is larger; wing over 205 mm, and has more white on the lower parts: the colour of the upper parts varies as in *malaccensis*.

South Bornean and West Javan birds have both been named:— *borneensis* (BP.) and *javanensis* STRESEMANN. We have male topotypes of the former, wings 180 and 190 mm., and two females from Saribas, Sarawak, wings 175 and 186 mm. The Javanese bird (type unique) has a wing of 175 mm and is said to have less white on the lower parts than *borneensis* (vide Orn. Monats., 1928. p. 54).

SHARPE renamed the Bornean bird, i.e., the smaller breeding race, *labuanensis*. A fair series from Labuan and North Borneo in the British Museum measures 177 - 193 mm.

The larger form, *N. s. scutulata,* has been recorded from all the areas of Malaysia. In the Peninsula it has only been taken in the winter months, i.e., it is a migrant.

In Malaysia the species is a difficult one: but, at any rate, we have small resident birds (wings under 205 mm) which I hesitate to separate into races on the material I have seen because individuals in one place vary considerably both in dimensions and colour (the Bornean-Javan birds may be distinct, they seem to average rather smaller): the first name given to any of these is *malaccensis*. Then we have larger visitors (wings over 205 mm) of one or more races: everywhere the majority of these are *N. s. scutulata* (? syn. *japonica* SCHL.), but *burmanica* HUME, occurs sporadically in the Peninsula (Malacca and Singapore, fide H. C. ROBINSON in litt.) and Borneo is probably visited

by birds from the Philippine Islands where more than one form occurs: fide Mc Gregor (Manual of Philippine Birds) who recognises three there under the names, *lugubris, scutulata* and *japonica.*

Below are the wing ranges in millimetres of some resident birds:—

Java	175.
Borneo	175 .... 193.
Sumatra	180 .... 201.
Malay Peninsula	184 .... 202.

TYTONIDAE.

Phodilus badius badius (Horsf.).

1 sex inc., Lampongs. (Vorderman coll.).

Wing 187 mm.

PSITTACIDAE.

Psittacula longicauda longicauda (Bodd.).

1 ♂, Lampongs. (Vorderman coll.).

1 ♂, 1 ♀, Lahat, Palembang.

1 ♂, Pangkalan Koto Baroe, Sumatra's Westkust (Groeneveld coll.).

Wings ♂ 145, 146, 156: ♀ 145 mm.

Psittinus cyanurus cyanurus (Forst.).

2 ♂, 1 ♀, Lampongs.

1 ♂, 1 ♀, Lahat, Palembang.

Wings ♂ 115, 116, 119: ♀ 115, 117 mm.

Coryllis galgulus galgulus (Linn.).

2 ♂, Wai Lima, Lampongs.

1 ♂, 1 ♀, Baleq, Acheen, 900 metres.

1 ♂, Aloer Poerba, Acheen.

Wings 84, 85, 85, 86: ♀ 90 mm.

PODARGIDAE.

Batrachostomus stellatus (Gould).

1 sex inc., Lahat, Palembang.

Wing 129 mm.

Batrachostomus javensis (Horsf.).

1 sex inc., Lampongs.

1 ♂, Loeboek lontjang, Palembang.

Wings 137, 137 mm.

The Lampongs specimen is bright rufous cinnamon with well-defined white markings, the other is blackish brown with the pale areas much more extensive but less clearly defined.

CORACIDAE.

Eurystomus orientalis orientalis (LINN.).

1 ♀ imm., Wai Lima, Lampongs.

1 ♂, Talang betoetoe, Palembang.

1 ♀, Lho Seumawe, Acheen.

Wings ♂ 179: ♀ 175 imm., 187 mm.

Eurystomus orientalis calonyx HODGS.

2 ♂, Talang betoetoe, Palembang.

Wings 180, 195 mm.

ALCEDINIDAE.

Ramphalcyon capensis cyanopteryx OBERH.

1 ♂, Pangkalan Koto Baroe, Sumatra's Westkust (STRASTERS coll.).

1 ♀, Medan, N. E. Sumatra.

1 ♀ Rampah, Acheen.

Wings ♂ 146: ♀ 149, 152 mm.

These birds, on locality, belong to the above race according to its proposer.

Ramphalcyon capensis arignota OBERH.

Proc. Biol. Soc. Wash. XXXVII, 1924, p. 136. Indragiri River, East Mid.-Sumatra.

1 ♂, 1 ♀, Palembang.

Wings ♂ 137: ♀ 147 mm.

These birds, on locality, belong to the above race according to its proposer. Sex for sex they happen to be smaller than the northern birds, but on colour I do not see how they can be separated. The males are perhaps of rather deeper blue above than males of the Javanese bird (*R. c. capensis*) which more nearly resemble the Sumatran females. The distribution attributed to the form is Southeastern Sumatra and Billiton Island.

Alcedo atthis bengalensis (GM.).

1 ♂, Takengon, Acheen, 1200 metres.

1 ♂, Rampah, Acheen.

Wings 70, 72 mm.

Alcedo euryzona TEMM.

1 ♂, Lahat, Palembang. (VORDERMAN coll.).

Lores rufous, back pale turquoise, tail coverts deeper blue.

Ceyx rufidorsus STRICKL.

Ceyx euerythra & *C. dillwynni* ROBINSON & KLOSS, Journ. Straits Branch, R.A.S., No. 80, 1919, p. 85.

2 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

1 ♂ imm., Blangkolan, Acheen, 1 ♂, Rampah, Acheen.

Wings 57 imm., 57, 58, 62 mm.

Halcyon chloris cyanescens (Oberh.).
1 ♂, Wai Lima, Lampongs.
1 ♂ imm., 1 ♀, Palembang.
Wings ♂ 102 imm., 112: ♀ 106 mm.

Halcyon concreta concreta (Temm.).
1 ♂, Poentian near Palembang Town. (Strasters coll.).
Wing 107 mm.

Lacedo pulchella pulchella (Horsf.).
1 ♀, Wai Lima, Lampongs.
Wing 97 mm.
The extent of the black banding on the under parts of the female varies considerably in all localities.

BUCEROTIDAE.

Buceros rhinoceros Linn., ? subsp. **sumatranus** Schleg. & Müll.
1 ♂, Djepara, Lampongs. (Tans coll.).
Wing 520; casque 160; bill from gape 276; tail 430 mm.
This example has the wing longer than the largest typical male I have seen from the Malay Peninsula (503 mm) and it may be that the use of the name proposed for Sumatran birds is justified (Verh. Nat. Ges., Zool., Aves p. 22, 1839—44). A female from Siak has also a longer wing (460 mm) than the largest Malayan female known to me (448 mm). Vide Treubia XII, 1930, p. 410—411.

Anthracoceros coronatus convexus (Temm.).
1 ♂, Poentian near Palembang Town (Strasters coll.).
Wing 316 mm.

Anthracoceros malayanus (Raffles).
1 ♂, Djambi (Posthumus coll.).
Wing 318 mm. Superciliary stripe grey.

MEROPIDAE.

Merops viridis Linn.
Merops sumatranus Auct.
2 ♀, Wai Lima, Lampongs.
2 sex inc., 2 ♀, Medan, N. E. Sumatra.
1 ♂, 1 ♀ Rampah, Acheen.
Wings ♂ 113: ♀ 108, 108, 108, 111, 111: ? 105, 106 mm.

Merops superciliosus javanicus Horsf.
1 ♂, 1 ♀, Wai Lima, Lampongs.
1 ♂, Palembang.
Wings ♂ 130: ♀ 129 mm.

Nyctiornis amicta (TEMM.).
1 ♂, Wai Lima, Lampongs.
1 ♂, Lampongs. (GOLDMAN coll.).
3 ♂, Palembang.
1 ♂, Pagar alam, Palembang, 500—750 metres.
1 ♂, Medan, N. E. Sumatra.
1 ♂ imm., Blangkolam, Acheen.
1 ♂, Aloer Poerba, Acheen.
2 ♂, Rampah, Aclheen.
Wings ♂ 124 imm., 126, 127, 128, 128, 128, 128, 130, 130, 133: ♀ 122 mm.

CAPRIMULGIDAE.

Caprimulgus affinis affinis HORSF.
1 ♂, 1 ♀, Aoer, Lahat, Palembang. (STRASTERS coll.).
1 ♂, 1 ♀, Palembang.
Wings ♂ 157, 159: ♀ 157, 159 mm.

Caprimulgus macrurus bimaculatus PEALE.
1 ♂, Aloer Poerba, Acheen.
Wing 195 mm.

MICROPODIDAE.

Chaetura leucopygialis (BLYTH).
1 sex inc., Lampongs. (VORDERMAN coll.).
Wing 118 mm.

Hemiprocne longipennis harterti STRESEMANN.
1 ♂, Palembang.
1 ♀, Koeto Alam, (STRASTERS coll.).
2 ♀, Medan, N. E. Sumatra.
Wings ♂ 153 (moulting): ♀ 165, 171, 175 mm.

Hemiprocne comata comata (TEMM.).
1 ♀, Lampongs (VORDERMAN coll.).
1 ♂, Pangkalan Koto Baroe, Sumatra's West Coast (STRASTERS coll.)
Wing ♂ 127: ♀ 125 mm.

TROGONIDAE.

Pyrotrogon diardi sumatranus (BLAS.).
1 ♂, 1 ♀, Wai Lima, Lampongs.
Wings ♂ 143: ♀ 136 mm.

Sumatran and Malayan birds differ from the typical Bornean form in that the crimson on the head of the male is confined to the occiput and nape.

Pyrotrogon erythrocephalus flagrans (MÜLL.).

2 ♂, Palembang.

1 ♀ Geureudong, Acheen, 900 metres.

Wings ♂ 126, 130: ♀ 136 mm.

The Sumatran race has the head and breast brighter and the white bars on the wing coarser in males than in continental birds: the bars on the wing are also coarser in females. The present female has patches of yellow on the lower breast.

Pyrotrogon duvauceli (TEMM.).

2 ♂, 1 ♀, Lampongs.

Wings ♂ 104, 106: ♀ 102 mm.

Pyrotrogon oreskios uniformis ROBINSON.

1 ♀, Wai Lima, Lampongs.

Wing 120 mm.

Hapalarpactes reinwardti mackloti (MÜLL.).

1 ♀, Palembang.

1 ♂ subad., 1 ♀ Redelong, Acheen, 1300 metres.

Wing ♂ 130: ♀ 123, 128 mm.

The male is an immature bird in female plumage just beginning to change on the wing coverts. The posterior undertail coverts are still dark buff.

CUCULIDAE.

Clamator coromandus (LINN.).

1 ♂, Talangbetoetoe, Palembang.

Wing 158 mm.

Surniculus lugubris brachyurus STRESEMANN.

1 ♂, 1 ♀, Palembang.

1 ♂, 1 ♀, Pekan Koto Baroe, Sumatra's Westkust (STRASTERS coll.).

Wings ♂ 121, 125: ♀ 117, 117 mm.

A bird from Siak with a wing of 143 mm has been named *S. l. massorhinus* by OBERHOLSER: "similar to *dicruroides* of Nepal, but larger." The large continental race attains a wing length of 148 mm: it occurs in the Malay Peninsula and on islands in the Straits of Malacca during the winter months and there is no reason why it should not also visit Sumatra: the type of *massorhinus* was collected in January.

Hierococcyx fugax fugax (HORSF.).

CHASEN and KLOSS, Journ. Fed. Malay States Mus. XIII, 1927, p. 277.

1 ♂, Wai Lima, Lampongs.

2 sex inc., imm. and juv., Lampongs. (VORDERMAN coll.).

1 ♂ imm., Palembang.

Wings ♂ 169 (worn), 173: ? 173 juv., 169 mm.

Bills, tip to nostril, 16.8, 16.8, 17.5, 18 mm.

The principal characters which separate this race from *H. f. nisicolor* (HODGS.), also occurring in Sumatra, are the larger bill and the broader pale and dark penultimate bands on the tail. Other characters of perhaps lesser value are, on the whole, correlated with these (vide CHASEN and KLOSS, l.c.s.). All Malaysian birds we have seen with back and wings as grey as the crown (i.e., fully adult) we refer to *H. f. nisicolor;* and all quite juvenile birds to *H. f. fugax* which suggests that the former are visitors and the latter resident. A third race of the species, *H. f. hyperythrus* (GOULD), is recorded as visiting North and East Borneo in the winter: it breeds in North China and Japan.

Hierococcyx sparveroides (VIG.).

1 sex inc., Lampongs (VORDERMAN coll.).

Wing 242 mm.

This appears to be the second record for Sumatra: the first being DE BEAUFORT and DE BUSSY's of a bird from Brastagi.

Cuculus micropterus concretus (S. MÜLL).

1 ♀, Rimbau pandjang, Sumatra's Westkust (OUWENS coll.).

Wing 166 mm.

Cuculus poliocephalus lepidus (S. MÜLL.).

1 ♀, Palembang.

Wing 141 mm.

It is now considered that this bird, (the Bornean mountain form of which is *insulinde* HARTERT) which has also been recorded as *musicus* LJUNGH, is actually the *lepidus* of MÜLLER, and that LJUNGH's *musicus* belongs to the Javanese race of *Penthoceryx sonnerati* recently listed as *P. s. pravata* (HORSF.), a somewhat later name.

Cacomantis merulinus subsp.

1 ♂, Wai Lima, Lampongs.

1 ♂, Lampongs.

1 ♂, 1 ♀ sex inc., Palembang.

1 ♂, Medan, N. E. Sumatra.

Wings ♂ 97, 99, 100, 102: ? 97: ♀ 98 mm.

The birds from the Lampongs and Medan are almost pale enough to be placed with the Javanese race *C. m. lanceolatus* (MÜLL.): the Palembang examples are *threnodes* CAB. & HEINE, (Malacca) if different from the typical form of the Philippines.

Cacomantis variolosus sepulcralis (MÜLL.).

1 ♂, Wai Lima, Lampongs.

1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

1 ♂, Palembang.

Wings 112, 114, 115 mm.

Penthoceryx sonnerati fasciolatus (MÜLL.).

ROBINSON & KLOSS, Journ. Fed. Malay States Mus. VIII, part 2, 1923, pp. 336, 359.

1 sex inc., Palembang.

Wing 102 mm.

Chalcites basalis (HORSF.).

1 ♀, Palembang.

Wing 104 mm.

Centropus bengalensis javanensis (DUMONT).

1 ♂, Isaq, Acheen, 1000 metres.

1 ♀, Rampah, Acheen.

Wings ♂ 133: ♀ 142 mm.

The black-breasted bird (wing 142) is, if correctly sexed, very small for a female.

Centropus sinensis bubutus (RAFFLES)

1 ♂, 2 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀, Aoer, Palembang. (STRASTERS coll.).

1 ♂, Palembang.

1 ♀, Pagar Alam, Palembang.

1 ♂, Rimbau Pandjang, Sumatra's West Coast. (OUWENS coll.).

1 ♂, Pangkalan Koto Baroe, Sumatra's West Coast. (OUWENS coll.).

1 ♀, Kajoetanam, Sumatra's West Coast (OUWENS coll.).

1 ♀ imm., Medan, N. E. Sumatra.

Wings ♂ 202, 208, 211, 215, 215: ♀ 215, 226, 226, 230, 232 mm.

The young female (wing 202) has the head and nape and upper tail-coverts streaked and barred with buff, foreneck, breast and undertail coverts with white, and the tail indistinctly barred with buff.

Zanclostomus javanicus pallidus ROB. & KLOSS.

1 ♂, 2 ♀, Wai Lima, Lampongs.

Wings ♂ 147: ♀ 145, 148 mm.

Sumatran and Bornean birds are inseparable from this Malayan form.

Rhopodytes tristis elongatus (MÜLL.).

1 ♀, Pagaralam, Palembang, 500—750 metres.

1 ♀, Rimbau pandjang, Sumatra's Westkust (OUWENS coll.).

Wings 149, 157 mm.

A somewhat variable race, the colour suffusing the grey breast varying from greyish-olive to olive-buff. These two examples practically represent the extremes in that respect.

Rhopodytes diardi diardi (LESS.).

2 ♂, 1 ♀, Wai Lima, Lampongs.
2 ♀, Aoer, Lahat, Palembang. (STRASTERS coll.).
1 ♀, Poentian near Palembang Town (STRASTERS coll.).
1 ♂, 1 ♀, Palembang.
1 ♂, Kajoe agoeng, Palembang (OUWENS coll.).
1 ♀, Aloer Poerba, Acheen.
Wings ♂ 130, 131, 132, 133: ♀ 129, 130, 131, 132, 132, 135 mm.

Rhinortha chlorophaea chlorophaea (RAFFLES).

2 ♂, 2 ♀, Wai Lima, Lampongs.
1 ♂, 1 ♀, Aoer, Lahat, Palembang. (STRASTERS coll.).
1 ♂, 1 ♀, Talang Betoetoe, Palembang.
1 ♂, 1 ♀, Palembang.
1 ♂, Pangkalan Koto Baroe, Sumatra's Westkust. (STRASTERS coll.).
2 ♂, Medan, N. E. Sumatra.
1 ♂, Tapatoean, W. Acheen.
1 ♀, Aloer Poerba, Acheen.
Wings ♂ 108, 110, 110, 111, 112, 113, 113, 117, 118: ♀ 111, 112, 114, 114, 116, 119 mm.

This series of topotypes shows the characters relied upon by BAKER to separate Bornean birds (foreneck and breast strongly washed with the ferruginous buff of the abdomen in females) are as common to Sumatran females as they are to Malayan. The female is equally variable everywhere, ranging from individuals with the foreneck and breast pure grey to others in which the tawny colour of the abdomen extends upwards to the throat.

Phoenicophaes curvirostris erythrognathus BP.

1 ♂, 2 ♀, Wai Lima, Lampongs.
1 ♂, 1 ♀, Aoer, Palembang. (STRASTERS coll.).
1 ♂, Talang betoetoe, Palembang.
1 ♂, 1 ♀, 1 sex inc., Palembang.
1 ♂, 1 ♀, Pangkalan Balei.
1 ♀, Medan, N. E. Sumatra.
1 ♀, Rampah, Acheen.
Wings ♂ 163, 166, 173, 173, 173: ? 166: ♀ 165, 167, 167, 169, 172, 172, 175 mm.
The median tail feathers in this race are sometimes entirely green.

CAPITONIDAE.

Calorhampus fuliginosus hayi (GRAY).

1 ♂, 1 ♀, Wai Lima, Lampongs.
1 ♂, Aoer Lahat, Palembang. (STRASTERS coll.).
2 ♂, 2 ♀, Talang betoetoe, Palembang.
1 ♀, Pangkalan Koto Baroe, Sumatra's Westkust. (STRASTERS coll.).

2 ♂, 1 ♀, Blangkolam, Acheen.

1 ♂, Aloer Poerba, Acheen.

Wings ♂ 77, 80, 81, 81, 82, 82, 83: ♀ 77, 78, 79, 79, 82 mm.

Variable in the amount of reddish-brown on the under-surface exactly as in Malayan birds so that *sanguinolentus* LESS., cannot be used.

Chotorhea chrysopogon chrysopogon (TEMM.).

3 ♂, Wai Lima, Lampongs.

1 sex inc., Djepara, Lampongs (TANS coll.).

1 ♂, 1 ♀, Palembang.

1 ♂, Aoer, Lahat, Palembang. (STASTERS coll.).

1 ♂, 1 sex inc., Geureudong, Acheen, 900 metres.

1 ♀, Rampah, Acheen.

Wings ♂ 128, 130, 130, 130, 131: ? 128, 132: ♀ 122, 126, 127 mm.

Chotorhea rafflesi (LESS.).

C. versicolor AUCT.

4 ♂, 1 ♀, Talang betoetoe, Palembang.

1 sex inc., Palembang.

Wings ♂ 113, 113, 117, 117: ? 120: ♀ 114 mm.

Chotorhea mystacophanes mystacophanes (TEMM.).

2 ♂, 1 ♀, Wai Lima, Lampongs.

1 sex inc., Lampongs (VORDERMANN coll.).

1 ♀, Poentilan near Palembang Town (STRASTERS coll.).

1 ♂, 1 ♀, Aoer, Lahat, Palembang (STRASTERS coll.).

2 ♂, Palembang.

2 ♂, Rampah, Acheen.

Wings ♂ 95, 95, 96, 97, 97, 99, 101: ? 97: ♀ 93, 97, 101 mm.

Cyanops oorti oorti (MULL.).

1 ♂, 1 sex inc., Palembang.

1 ♂, Baleq, Acheen, 900 metres.

Wings ♂ 91, 96: ? 93 mm.

Mesobucco duvauceli duvauceli (LESS.).

1 ♀, Kajoe tanam, Priaman, Sumatra's Westkust (OUWENS coll.).

1 ♂, 1 ♀ imm., Rampah, Acheen.

Wings ♂ 74: ♀ 78 mm.

Xantholaema haemacephala delica (PARROT).

Xantholaema haemacephala rafflesius (Boie. Nomen nudum) ROBINSON and KLOSS, Journ. Straits Branch, R.A.S. No. 81, 1920, p. 95.

2 ♀, Wai Lima, Lampongs.

1 ♂, 2 ♀, Aoer, Lahat, Palembang.

2 ♀, Palembang.

1 ♂, 2 ♀, Pangkalan Koto Baroe, Sumatra's Westkust. (STRASTERS coll.).

3 ♀, 1 sex inc., Medan, N. E. Sumatra.

1 ♂, 1 ♀ Isaq, Acheen, 1000 metres.

Wings ♂ 73, 78: ? 73: ♀ 73, 74, 74, 74, 75, 75, 75, 75, 77, 78, 79 mm.

Psilopogon pyrolophus MÜLL.

1 ♂, 1 ♀, Palembang.

7 ♂, 2 ♀, Redelong, Acheen, 1300 metres.

1 ♂, 2 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 114, 118, 121, 122, 124, 125, 127, 128: ♀ 116, 120, 122, 127, 127 mm.

Females are without any crimson wash on the occiput.

PICIDAE.

Picus puniceus observandus HARTERT.

2 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, Palembang.

2 ♂, 1 ♀, Aoer, Lahat, Palembang (STRASTERS coll.).

1 ♀, Peloempang, ? Sumatra's Westkust (OUWENS coll.).

1 ♂, Medan, N. E. Sumatra.

1 ♀ Baleq, Acheen, 900 metres.

1 ♀ Aloer Poerba, Acheen.

1 ♀ Rampah, Acheen.

Wings ♂ 121, 121, 122, 123, 127, 127: ♀ 126, 126, 128, 128, 130, 130 mm.

Picus chlorolophus vanheysti (ROB. & KLOSS).

Brachylophus chlorolophus vanheysti, ROBINSON & KLOSS, Journ. Straits Branch, Royal Asiat. Soc., No. 80, 1919, p. 97 (Bandar Baroe, Deli and Mt. Ophir, Padang).

1 ♀, Isaq, Acheen, 1000 metres.

2 ♂, Redelong, Acheen, 1300 metres.

Wings ♂ 129, 130: ♀ 125 mm.

This bird has a general resemblance to the more common *P. p. observandus*, but besides having much less red on the head and wings it has an area of whitish feathers before and below the eye.

Callolophus miniatus malaccensis (LATH.).

1 ♂, Wai Lima, Lampongs.

1 ♂, 1 ♀, Palembang.

1 ♂, Talang betoetoe, Palembang.

1 ♂ juv., 1 ♀ juv., Batoe Sangkar. (OUWENS coll.).

1 ♂, Sumatra. (VAN DER PLAS coll.).

1 ♂, Tapatoean.

1 ♂, Medan, N. E. Sumatra.

1 ♂, 1 ♀ Lho Seumawe, Acheen.

Wings ♂ 121 (worn), 122, 123, 127, 131: ♀ 123, 126, 127 mm.

Chrysophlegma mentale humei Hargitt.
3 ♂, 2 ♀, Wai Lima, Lampongs.
1 ♂, 1 ♀, Palembang.
2 ♀, Medan, N. E. Sumatra.
1 ♂, Geureudang, Acheen, 900 metres.
1 ♂, Aloer Poerba, Acheen.
Wings ♂ 128, 128, 129, 131, 132, 135: ♀ 129, 129, 132, 132, 134 mm.

Chrysophlegma flavinucha mystacale Salv.
1 ♀, Palembang.
1 ♂, Deli, N. E. Sumatra.
1 ♂, Isaq, Acheen, 1000 metres.
1 ♀, Baleq, Acheen, 900 metres.
Wings ♂ 142, 146: ♀ 139, 141 mm.

Chloropicoides rafflesi rafflesi (Vig.).
1 ♀, Wai Lima, Lampongs.
1 ♂, Pagar alam, Palembang, 500—750 metres.
Wings ♂ 130: ♀ 138 mm.

Dryobates moluccensis moluccensis (Gm.).
Dryobates nanus auritus Stresemann (nec Eyton) Ach. f. Naturges., 1921, Abh. A, p. 73.
2 ♂, 1 ♀, Wai Lima, Lampongs.
1 ♂, 1 ♀, Palembang.
1 ♂ Pangkalan Koto Baroe, Sumatra's West Coast (Strasters coll.).
2 ♀, Medan, N. E. Sumatra.
Wings ♂ 74, 76, 78, 78: ♀ 76, 76, 77, 78 mm.

In his review of Sumatran Woodpeckers Stresemann has used *auritus* for this bird, but the name really applies to the southern Malayan race of *D. hardwickii* re-described by Robinson and Kloss under the name *D. canicapillus suffusus.*

Blythipicus rubiginosus parvus Chasen & Kloss.
Journ. f. Ornith., 1929, Bd. 2, p. 112 (Borneo).
3 ♂, 1 ♀, Wai Lima, Lampongs.
2 ♀, Palembang.
2 ♂, Peloempang, ? Sumatra's Westkust. (Ouwens coll.).
1 ♂, Baleq, Acheen, 900 metres.
1 ♂ Rampah, Acheen.
Wings ♂ 113 (imm.), 116, 117, 117, 117, 117, 118: ♀ 119, 119, 122 mm.

The small size of both Bornean and Sumatran birds distinguishes them from the typical Malayan form in which the wing-length varies from 122 to 130 mm.

Meiglyptes tristis micropterus HESSE.

4 ♀, Wai Lima, Lampongs.

1 ♀, Blangkolam, Acheen.

1 ♂, Aloer Poerba, Acheen.

1 sex inc., Lahat, Palembang (VORDERMAN coll.).

Wings ♂ 98: ? 95: ♀ 90, 92, 94, 94, 94, 95 mm.

Meiglyptes tukki tukki (LESS.).

1 ♂, Wai Lima, Lampongs.

1 ♀, juv. Medan, N. E. Sumatra.

1 ♂, Blangkolam, Acheen.

1 ♀, Rampah, Acheen.

Wings ♂ 99, 100: ♀ 95 mm.

Micropternus brachyurus badius (RAFFLES).

1 ♂, 1 ♀, Lampongs. (VORDERMAN coll.).

1 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, Boengamas, Lahat, Palembang.

1 ♀, Pagar alam, Palembang, 500—750 metres.

2 ♂, 1 ♀, Medan, N. E. Sumatra.

2 ♂, 1 ♀, Isaq, Acheen, 1000 metres.

Wings ♂ 108, 112, 113, 113, 114, 114, 117: ♀ 108, 110, 112, 114, 114 mm.

It seems just possible to maintain *squamigularis* (Sund.) as distinct from this form on account of the more profuse and marked barring shown by the great majority of the Malayan birds.

Dinopium javanense javanense (LJUNGH).

Dinopium javanense palmarum STRESEMANN.

1 ♂, Palembang.

1 ♂, 1 ♀, Talang betoetoe, Palembang.

2 ♂, 1 ♀, Pangkalan Koto Baroe, Sumatra's West Coast (STRASTERS coll.).

1 ♀ imm. Koeto Gedang, Sumatra's West Coast (OUWENS coll.).

1 ♂, 2 ♀, Medan, N. E. Sumatra.

2 ♂, 1 ♀, Isaq, Acheen 1000 metres.

Wings ♂ 126, 126, 127, 129, 131, 131, 132; ♀ 121, 123, 124, 126, 130 mm.

Chrysocolaptes validus xanthopygius FINSCH.

1 ♂, 1 ♀, Lampongs. (VORDERMAN coll.).

1 ♂, Lampongs (TANS coll.).

4 ♂, 2 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀, Palembang.

1 ♂, 1 ♂, Juv., Talang betoetoe, Palembang.

1 ♂, Baleq, Acheen, 900 metres.

1 ♂, Geureundang, Acheen 900 metres.

2 ♂, Blangkolam, Acheen.

Wings 152, 152, 154, 155, 155, 155, 158, 158, 158, 158, 158, 159, 162: ♀ 150, 150, 152, 155, 159 mm.

Hemicircus concretus coccometopus RCHB.

2 ♂ ad., 2 ♂ imm., 1 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀, Palembang.

1 ♂ imm., Batoe Gedang, Sumatra's West Coast (OUWENS coll.).

1 ♂, Aloer Poerba, Acheen.

Wings ♂ 82, 84, 84, 86, 79 imm., 82 imm., 84 imm.; ♀ 83, 84 mm.

Birds from Sumatra, and also Borneo, average smaller than *sordidus*, their wings not apparently attaining the maximum of the Malayan form.

Thriponax javensis javensis (HORSF.).

1 ♂, 2 ♀, Talang betoetoe, Palembang.

Wings ♂ 230: ♀ 206, 210 mm.

Sasia ochracea abnormis (TEMM.)

1 ♀, Rampah, Acheen.

1 ♀ Aloer Poerba, Acheen.

Wings 53, 55 mm.

Vivia innominata malayorum (HARTERT).

1 ♂, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wing 60 mm.

One of the rarest of Malaysian woodpeckers.

BAKER states that *Picumnus*, the generic name by which this bird has hitherto been known, is based on an American species not congeneric with the Eastern birds.

EURYLAIMIDAE.

Calyptomena viridis viridis RAFFLES.

1 ♂, 1 ♀, Aloer Poerba, Acheen.

Wings ♂ 94: ♀ 105 mm.

Serilophus lunatus rothschildi HARTERT & BUTLER.

2 ♂, Redelong, Acheen, 1300 metres.

Wings 83, 83 mm.

These specimens appear to be inseparable from examples of *S. l. rothschildi* from Perak and the southern half of the Malay Peninsula: whereas *S. l. intensus* ROB. & KLOSS, (terra typica, Korinchi) of south and central Sumatra and the neighbourhood of Brastagi, at the north end of Lake Toba, is much more like *S. l. stolidus* ROB. & KLOSS, of the northern half of the Malay Peninsula by reason of its much browner upperparts, both in shade and extent. *S. l. intensus* is the darkest of the three forms, being a deeper brown above and a deeper grey below. There is practically no difference between the underparts

of *rothschildi* and *stolidus*, but the latter is suffused with pronounced buff above except on the forehead.

This is an addition to the list of Sumatran forms.

Eurylaimus javanicus harterti VAN OORT.

2 ♂, Aloer Poerba, Acheen.

1 ♂ ad., 1 ♂ juv., 1 ♀ juv., Geureudong, Acheen, 900 metres.

Wings ♂ adults 106, 108, 109 mm.

A juvenile male (wing 101 mm) from Wai Lima, Lampongs (23 Nov. 1921) has been recorded as *E. j. javanicus* HORSF., *) but I am by no means certain of the identification as juveniles of *harterti* possess the yellow under-tail coverts retained in the adult Javanese bird. For the present the typical form should be regarded as not proved to occur in Sumatra though it may very likely exist in the extreme south.

Eurylaimus ochromalus ochromalus RAFFLES.

2 ♀, Poentian near Palembang Town. (STRASTERS coll.).

1 ♂, 1 ♀, Talang betoetoe, Palembang.

1 ♂, Loeboek karet, ? Palembang.

2 ♂, 1 ♀, Aloer Poerba, Acheen.

Wings ♂ 78, 79, 79, 82: ♀ 75, 77, 80, 82 mm.

Corydon sumatranus sumatranus (RAFFLES).

1 ♂ juv., 2 ♀, Wai Lima, Lampongs.

2 ♂, Djepara, Lampongs (TANS coll.).

2 ♂, 1 ♀, 1 ♀ juv., Aloer Poerba, Acheen.

Wings ♂ 128, 128, 130, 135: ♀ 130, 131, 139 mm.

The youngest bird (wing 104) is brownish black, lacks the yellow patch on the back and has the throat white. The other young example (wing 130) is black, but otherwise agrees with it.

Cymborhynchus macrorhynchus lemniscatus (RAFFLES).

1 sex inc., Lampongs. (VORDERMAN coll.).

1 ♂, 1 sex inc., Palembang.

1 ♂, Poentian near Palembang Town. (STRASTERS coll.).

1 ♂, 1 sex inc., Aoer, Lahat Palembang. (STRASTERS coll.).

1 ♂, imm., Talang betoetoe, Palembang.

2 sex inc., Sumatra. (GOLDMAN coll.).

1 ♂, Deli, N. E. Sumatra.

1 ♀, Blangkolam, Acheen.

1 ♂, 2 ♀, Rampah, Acheen.

Wings ♂ 100, 100, 103, 104, 105: ? 100, 102, 103, 104: ♀ 98, 99, 100 mm.

White bars occur on the tail feathers of all these examples, except one, and are confined to the inner webs.

*) Journ. Fed. Malay States Mus., VIII, Part II, 1923, pp. 339, 359.

PITTIDAE.

Pitta brachyura cyanoptera TEMM.

Pitta moluccensis Auct.

1 ♀, Kajoetanam, Priaman, Sumatra's Westkust (OUWENS coll.).

1 ♂, 1 sex inc., Tapatoean, West coast of Acheen.

Wings ♂ 117; ? 117; ♀ 116 mm.

Pitta granatina coccinea EYTON.

1 ♂ Rampah, Acheen.

Wing 92; bill from gape 28, from nostril 16 mm.

I think that *P. g. vanheurni* (KLOSS, Journ. Fed. Malay States Mus., X, 1921, p. 212. Langkat, N. E. Sumatra) based on a bird with an unusually large bill, may have to be suppressed.

Pitta cucullata bangkana SCHLEG.

Pitta bangkana SCHLEG., Vog. Ned. Ind., Pitta, 1863, p. 8, pl. 2, fig. 5; id. Mus. Pays-Bas, III, Pitta, 1863, p. 3; Wallace, Ibis, 1864, p. 106 (Banka).

Pitta cucullata, WALLACE, Ibis, 1864, p. 106 (Palembang) ?: VORDERMAN, Nat. Tijd. Ned. Ind., L. 1891, p. 488 (Billiton).

Pitta atricapilla bangkana PARROT, Abh. K. Akad. Wiss., II, Kl. XXIV, Bd. 1, 1907, p. 219 (Banka).

1 sex inc., Palembang.

Wing 110 mm.

This specimen has the top of the head markedly darker brown than *P. cucullata* HARTL., of the Malay Peninsula and the black portions of the feathers are larger and more visible than in the Malayan bird. It is possibly a little immature, but as it seems to agree with the four Banka examples described by PARROT (q.v.) I retain *bangkana* and use the name for this Sumatran bird, for it is quite possible that the birds of Banka and other southern localities are different from the continental and northern Sumatran form.

SCHLEGEL, after proposing *bangkana,* finally listed examples from Northern India, Malacca and Banka under "*Pitta cucullata* et *bangkana*" (Mus. Pays-Bas, III, Revue Pitta, 1874, pp. 2, 5) stating that in young birds only the edges of the crown-feathers were brown, the remaining part being black or blackish: i.e., on reconsideration he regarded the types of *bangkana* as immature individuals: and VORDERMAN, considering that SCHLEGEL had reduced *bangkana* to a synonym of *cucullata,* listed birds from Billiton under the latter name. They, and specimens from Banka, require re-examination as does PRILLWITZ' example from West Java in the Tring Museum (vide BARTELS and STRESEMANN, Treubia XI, 1929, p. 120).

P. c. cucullata occurs on continental Asia and is common at times on islands in the Straits of Malacca. Individually it varies appreciably in the tone of the blue areas and the extent of white on the wing. In a number of examples the green and blue feathers exhibit a dark median line so that the plumage

appears to be striped with brown or black. The Nicobar Island bird has been named *abbotti* by RICHMOND and the species also occurs on Sumatra, Banka, Billiton, Nias (fide BÜTTIKOFER), and Java.

Pitta sordida sumatrana subsp. nov.

Pitta atricapilla VORDERMAN, Nat. Tijd. Ned. Ind., XLI, 1881, pp. 126, 129 (Lahat, Palembang).

Pitta muelleri WALLACE, Ibis, 1864, p. 106 (Palembang); NICHOLSON, Ibis, 1882, p. 63 (Lampongs).

Pitta mülleri VORDERMAN, op cit., LI, 1891, p. 232 (Lampongs).

1 ♂, Lampongs.

1 ♂, Palembang.

Wings 105, 108 mm.

Like *Pitta sordida mülleri* Bp., of Borneo, but with the black tips to the primaries much larger, the white area of the wing being proportionately reduced, and not extending to the outer web of the first primary, though this is sometimes edged with white. Length of the black tips of the second primary 35—40 mm: in *mülleri* 15—20 mm only. Tail more broadly tipped with blue. Size apparently a little smaller than *mülleri.*

Type. Adult male from Palembang collected on 1 January, 1920. BRAUTIGAM coll. In Mus. Zool. Buitenzorg.

Wing 108 mm.

Possibly GOULD's skin from Banka in the British Museum of Natural History recorded by SCLATER (Catalogue of Birds, XIV, p. 440) under *P. muelleri* should be placed here.

P. s. mülleri occurs throughout Borneo and on Sibutu Id., N. E. Borneo *).

The black-headed green Pitta of Java is also distinct and I take the opportunity to describe it below.

In Malaysia the species occurs in the Palawan group, Borneo, Sumatra, Banka (fide SCLATER) and Java. Thus both the species *sordida* and *cucullata,* so closely resembling each other except in the colour of the crown that were it not for their distribution they might be regarded as one species, seem to occur together in Sumatra, Banka and Java only.

Pitta sordida javana subsp. nov.

Pitta mülleri AUCT.; VORDERMAN, Nat. Tijd. Ned. Ind. XLIV, 1884, p. 214 (Batavia, Java).

Like *P. sordida mülleri* but with the white area of the wing even more reduced than in *P. sordida sumatrana,* not extending to the outer webs or the first and second primaries and reaching the first primary only as a small patch on the edge of the inner web. Size and tail as in *sumatrana*; size smaller and apparently the tail more broadly tipped with blue than in *mülleri* of Borneo.

*) *Pitta mülleri* was said by BONAPARTE to be from Celebes but the name is based on MÜLLER and SCHLEGEL's *P. atricapilla* which referred to birds from Borneo. The type locality is thus erroneus and no green Pitta with a white wing-patch occurs on Celebes. The terra typica of *P. mülleri* is S. E. Borneo (Doesun R.).

Type. Adult female from Bandjar, on the boundary between West and Mid Java, in Mus. Zool., Buitenzorg.

Wing 105 mm.

Of the three Malaysian races, the Bornean form may be described as a white-winged bird having the primaries black-tipped, the white extending over the outer web of the first primary for a length of 30 mm or more: *sumatrana* as a black-winged bird with a white patch which does not reach the outer web of the first primary: and *javana* as a black-winged bird with a yet smaller white patch which only just reaches the inner web of the first primary.

According to Dr. K. W. DAMMERMAN this Pitta is confined in Java to the western third of the island.

Eucichla guajana irena (TEMM.).

1 ♀, Lampongs (VORDERMAN coll.).

1 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀, Loeboek lontjang, Palembang.

1 ♀, Pagar Alam, Palembang, 500—750 metres.

1 ♂, Talang Betoetoe, Palembang.

1 ♀, Aloer Poerba, Acheen.

Wings ♂ 100, 102, 104: ♀ 101, 102, 102, 106 mm.

The type came from North Sumatra and was described by TEMMINCK as having the under parts blue from the bill. This, however, is a *lapsus calami* as the blue under parts commence at the base of the foreneck.

HIRUNDINIDAE.

Hirundo rustica gutturalis SCOP.

1 ♂, Wai Lima, Lampongs.

1 ♀, 1 sex inc., Palembang.

Wings ♂ 110: ? 112: ♀ 112 mm.

Hirundo tahitica javanica SPARRM.

1 ♀, Wai Lima, Lampongs.

Wing 103 mm.

Inseparable from a series of Javanese birds.

OBERHOLSER states that Sumatran birds apparently, and southern Malayan birds probably, belong to his proposed race *H. t. hypolampra* from Nias *). It is a pity that when describing this form he did not compare it with his earlier *H. t. abbotti* from the Anamba Islands instead of with the more distant form *H. t. domicola* of Southern India. We refer Bornean, Malayan and North Sumatran birds to *abbotti,* a form with a rather darker foreneck than *javanica.*

*) Journ. Wash. Acad. Sci., 16, 1926, p. 515.

MUSCICAPIDAE.

Hemichelidon ferruginea HODGS.

1 sex inc., Lampongs (VORDERMAN coll.).

Wing 71 mm.

Alseonax latirostris latirostris (RAFFL.).

1 sex inc., Lampongs (VORDERMAN coll.).

1 ♂, 1 sex inc., Wai Lima, Lampongs.

Wings ♂ 70: ? 70, 69 mm.

Cyornis rufigastra rufigastra (RAFFL.).

Cyornis rufigastra rufigastra CHASEN and KLOSS, Bull. Raffles Mus. No. 2, 1929, p. 36.

1 ♂, Palembang.

1 ♂, Kandang, Lho Seumawe, Acheen.

Wing 72, 72 mm.

In the absence of properly associated females it is not easy to distinguish between the males of *C. banyumas cantatrix* (TEMM.) of Western Java and those of *C. r. rufigastra*: but the bright forehead and superciliaries in the latter are not so pale as in *cantatrix*; and *rufigastra* (of Sumatra and the Malay Peninsula at least) seems to be a trifle smaller. The wings of fourteen males of *cantatrix* measure 75—77 mm; of eleven Malayan-Sumatran *rufigastra* 71—75 mm.

Anthipes solitaria subsp.

1 ♀ subad., Baleq, Acheen, 900 metres.

Wing 66 mm.

This specimen is so much less saturate than topotypes from the neighbourhood of Padang and so closely resembles *A. s. malayana* from the Malay States that I should have no hesitation in referring it to the latter race were it not rather immature. It may well be, however, that birds of the north of Sumatra are the same as those of the same latitude in the Peninsula.

Niltava vivida sumatrana SALV.

1 ♂, Korinchi Peak, 3000 metres (ROBINSON & KLOSS coll.).

7 ♂, 4 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 80, 80, 80, 80, 81, 82, 83, 84: ♀ 79, 80, 81, 82 mm.

One of the males still retains traces of juvenile plumage in the form of large tawny spots on the back and wing-coverts. The under tail-coverts of the females vary from pale buff to deep tawny.

Niltava grandis decipiens (SALV.).

1 ♂, Isaq, Acheen, 1000 metres.

2 ♂, Redelong, Acheen, 1300 metres.

Wings 92, 95, 97 mm.

Poliomyias mugimaki (Temm.).

2 ♂ imm., 4 ♀, Wai Lima, Lampongs. January.

1 ♂ ad., Fort de Kock, Sumatra's Westkust, 1000 metres. December. (Groeneveld coll.).

Wings ♂ 72, 74, 76: ♀ 70, 70, 71, 72 mm.

Dendrobiastes hyperythrus sumatranus Hachisuka.

Bull. B.O.C. XLVII, 1926, p. 52. Korinchi.

1 ♂ subad., 1 ♂ juv., Redelong, Acheen, 1300 metres.

1 ♂ ad., 1 ♂ subad., 1 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 58, 59, 59: ♀ 57 mm.

I use the name given to Sumatran birds though I am still by no means certain that they differ materially from *D. h. malayana* (O.-Grant) of the Malay Peninsula.

Muscicapula melanoleuca westermanni Sharpe.

Muscicapula melanoleuca westermanni Robinson & Kloss, Journ. Fed. Malay States Mus., VIII, Part 2, 1918, p. 160 (Korinchi)?; id., op. cit. XI, 1924, p. 272 (Partim. Padang Highlands)?.

1 ♂, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

2 ♂ ad., 3 ♂ juv., 1 ♀ ad., Redelong, Acheen, 1300 metres.

Wings ♂ 57, 58, 58 (55, 56, 56 juv.): ♀ 55 mm.

This Malayan race will probably be found, on the acquisition of females, to occur in the central parts of the island as well as in the north.

Muscicapula melanoleuca hasselti (Temm.).

Muscicapula melanoleuca westermanni Robinson & Kloss, (part.), Journ. Fed. Malay States Mus. XI, 1924, p. 272 (Mt. Kaba, Benkoelen; Mt. Dempu, Palembang)?.

1 ♀, Lampongs (Vorderman coll.).

Wing 55 mm.

This specimen belongs to the Javanese form in which the females have the upper parts strongly suffused with russet and the breast and flanks tinged with brown, whereas the Malayan female (*westermanni* Sharpe) is clear grey on those areas except on the rump and upper tail-coverts.

Males from Java, Sumatra and the Malay Peninsula are indistinguishable and hitherto I have only examined specimens of that sex from Sumatra: but those from Mt. Kaba and Mt. Dempu probably belong to this Javanese race which is possibly confined in Sumatra to the south only.

Cyanoptila cyanomelana subsp.

1 ♀, Wai Lima, Lampongs. December 1921.

Wing 88 mm.

I have a precisely similar female from the valley of Korinchi (wing 87 mm) and have recorded a pair (no longer available) from Mt. Sibajak, N. E. Sumatra, as *C. bella* (Journ. Straits Branch, Roy. Asiat. Soc., No. 81, 1920,

p. 98). BARTELS and STRESEMANN listed both *cumatilis* and the typical race in Java (Treubia, XI, 1929, p. 122). These flycatchers only occur in Malaysia as occasional migrants and without topotypes I find it impossible to determine solitary females subspecifically. I have, however, before me of Malaysian birds adult and immature males of *C. c. cyanomelana* (TEMM.) from Borneo and other males from the Malay Peninsula and Sumatra which appear to be *C. c. cumatilis* THAYER and BANGS. All winter birds.

Xanthopygia narcissina xanthopygia (HAY).

1 ♂ imm., Aloer Poerba, Acheen.

In female plumage. Wing 72 mm.

Hypothymis azurea prophata OBERH.

1 ♀, Wai Lima, Lampongs.

1 ♂, Baleq, Acheen, 900 metres.

1 ♂, Aloer Poerba, Acheen.

Wings ♂ 72, 74 ♀ 67 mm.

Rhipidura albicollis atrata SALV.

1 ♂, Isaq, Acheen, 1000 metres.

1 ♂, Redelong, Acheen, 1300 metres.

Wings 80, 82 mm.

Rhipidura javanica longicauda WALLACE.

1 ♀, Pangkalan Koto Baroe, Sumatra's Westkust.

1 ♀, Medan, N. E. Sumatra.

Wings 73, 73 mm.

The typical form seems to be confined to Java: it is a little more tinged with ferruginous above and below than *longicauda* to which can be referred, as well as birds of Sumatra, those of the Malay Peninsula and Borneo.

Terpsiphone paradisi affinis (HAY).

1 ♂, Lampongs (VORDERMAN coll.).

1 ♂, Wai Lima, Lampongs.

Wings 92, 91 mm.

Tersiphone paradisi incii (GOULD).

1 ♂, Wai Lima, Lampongs.

Wings 87 mm.

Tersiphone atrocaudata atrocaudata (EYTON).

Terpsiphone princeps AUCT.

1 ♂, Lampongs (VORDERMAN coll.).

Wing 92 mm.

Drymophila pyrrhoptera pyrrhoptera (TEMM.).

1 ♂, Aloer Poerba, Acheen.

Wing 82 mm.

Rhinomyias umbratilis umbratilis (STRICKL.).

Rhinomyias umbratilis richmondi STONE, Proc. Acad. Nat. Sci., Philadelphia LIV. 1902, p. 686. Mansalar Id., W. Sumatra.

1 ♂, Palembang.

Wing 75 mm.

The Academy of Natural Sciences is in possession of STRICKLAND's Bornean type and STONE separated birds of the Sumatran area on account of their olivaceous colour, the old type being now tawny-brown. The latter colour is, however, merely the result of long-continued post-mortem change to which all olivaceous-brown Timeliads and Pycnotids are subject.

Rhinomyias olivacea olivacea (HUME).

1 ♂, 1 ♀, Isaq, Acheen, 1000 metres.

1 ♂, Baleq, Acheen, 900 metres.

1 ♂ imm., 1 ♀, Geurendong, Acheen, 900 metres.

Wings ♂ 74 imm., 76 imperfect, 78: ♀ 71, 72 mm.

Culicicapa ceylonensis ceylonensis (SWAINS.).

CHASEN & KLOSS, Journ. Fed. Malay States Mus., XIII, 1927, p. 279.

4 ♂, Redelong, Acheen, 1300 metres.

Wings 58, 60 imm., 61, 62 mm.

Abrornis superciliaris schwaneri (BLYTH).

1 ♂, Isaq, Acheen, 1000 metres.

Wing 58 mm.

Cryptolopha trivirgata trivirgata (STRICKL.).

1 ♂, Korinchi Peak, 3000 metres. (ROBINSON & KLOSS coll.).

1 ♂, Isaq, Acheen, 1000 metres.

1 ♂, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

1 ♀, Redelong, Acheen, 1300 metres.

Wings ♂ 59, 60, 63: ♀ 56 mm.

Cryptolopha montis inornata ROB. & KLOSS.

Journ. Straits Branch, Royal Asiatic Soc., No. 81, 1920, p. 99 (Bandar Baroe, near Brastagi, N. E. Sumatra).

2 ♂, Redelong, Acheen, 1300 metres.

Wings 55, 56.5 mm.

Differing from the typical Bornean bird in the darker chestnut of the crown, nape and sides of head. The Malayan race, *C. m. davisoni* SHARPE, is distinguished from both by the possession of a marked yellow rump-band.

Stoparola indigo ruficrissa (SALV.).

1 ♂, 1 ♀, Korinchi Valley, 1000 metres (ROBINSON & KLOSS coll.).

3 ♂, 1 ♀, Redelong, Acheen, 1300 metres.

1 ♂, 2 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 75, 75, 77, 77, 78: ♀ 72, 75, 75, 77 mm.

Stoparola thalassina thalassoides (CAB.).
Stoparola melanops AUCT.
1 ♂, 1 ♀, Wai Lima, Lampongs.
2 ♂, Palembang.
1 ♀, Aloer Poerba, Acheen.
Wings ♂ 74, 75, 77, 77: ♀ 76 mm.

CAMPEPHAGIDAE.

Coracina sumatrensis sumatrensis (S MÜLL.).
1 ♂, 1 ♀, Palembang.
1 ♀, Aoer, Palembang. (STASTERS coll.).
Wings ♂ 153: ♀ 145, 147 mm.

Lalage fimbriata culminata (HAY).
1 ♂, Lampongs. (VORDERMAN coll.).
Wing 102 mm.

Lalage nigra nigra (FORST.).
Lalage nigra brunnescens BAKER.
2 ♀, Wai Lima, Lampongs.
1 ♂, Palembang.
1 ♀, Aloer, Lahat, Palembang. (STRASTERS coll.).
1 ♂, Boekit Gadang, Sumatra's Westkust.
1 ♂, 1 ♀, Medan, N. E. Sumatra.
1 ♂, 1 ♀, Lho Seumawe, Acheen.
Wings ♂ 85, 88, 89, 91: ♀ 86, 87, 89, 93 mm.
I have dealt with the names of this species in Journ. Malayan Branch, Royal Asiat. Soc. IV, 1926, pp. 158—161, and V, 1927, p. 351.

Pericrocotus flammeus xanthogaster (RAFFL.).
6 ♂, 2 ♀, Wai Lima, Lampongs.
2 ♂, Palembang.
1 ♀, Talang Betoetoe, Palembang.
Wings ♂ 82, 83, 84, 85, 85, 85, 85, 86: ♀ 79, 81, 83 mm.

Pericrocotus igneus igneus BLYTH.
1 ♀, Wai Lima, Lampongs.
Wing 75 mm.

Pericrocotus montanus montanus SALV.
1 ♂ ad., 1 ♂ imm., Isaq, Acheen, 1000 metres.
1 ♂, Takengon, Acheen, 1200 metres.
1 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.
Wings ♂ 80 imm., 82, 82: ♀ 79 mm.

The young male is of unusual colouration: instead of the yellow areas of the juvenile plumage (which is that of the female) changing to red in patches they have turned to deep orange except for one or two spots which are still yellow.

Pericrocotus miniatus miniatus (TEMM.).

1 ♀, Korinchi Peak, 2200 metres. (ROBINSON & KLOSS coll.).

Wing 81 mm.

PYCNONOTIDAE.

Aegithina viridissima viridissima (BP.).

1 ♀, Aloer Poerba, Acheen.

Wing 63 mm.

Aegithina tiphia (?) micromelaena OBERH.

1 ♂, Palembang.

1 ♂, Aoer, Lahat, Palembang.

1 ♀, Talang Betoetoe, Palembang.

2 ♂, 3 ♀, 1 sex inc. juv., Medan, N. E. Sumatra.

1 ♂, Blangkolam, Acheen.

Wings ♂ 60, 61, 62, 62, 65: ♀ 61, 61, 62, 64, 64 mm.

The Malaysian forms of this species require consideration. Having no typical material of *tiphia* (Bengal) I quote HUME's review to show that the Malayan bird is not *Ae. t. tiphia.* "Passing into Burma, though the *tiphia* type may prevail, the variations become more numerous and conspicuous. Birds with the entire nape and back black, or the entire crown and nape black, and the back much fringed with that colour are not uncommon and become more and more so I believe as you go south, until at Singapore the majority, I believe, of the males when in breeding plumage exhibit a considerable amount of black on the upper surface and some at any rate occur of the purely typical *multicolor* type [the Ceylon and South Indian race]. We preserved a great many of these birds in the Malay Peninsula. That the yellow of the throat, etc., of *many* Malayan specimens is far more golden than those of Calcutta or even the great majority of North Burmese birds is undeniable but that is because in this, as in other points as you go south, the species reverts more and more to the Southern Indian type" (Stray Feathers V, 1877, p. 440).

Sumatran birds only appear to differ from southern Malayan *multicolor*-like ones [1]) in that males do not seem to assume the intense black plumage described by HUME. No name has been given to them but as they are unlikely to differ appreciably from the bird of Banka Island they may be called *Ae. t. micromelaena* OBERHOLSER, [2]) the description of which seems to apply sufficiently. Birds from Peninsula Siam and the more northern of the Malay States also seem to agree with the small Sumatran series before me.

In Borneo the males of this species are not known to assume any black

[1]) *Ae. t. singapurensis* C. & K., Bull. Raffles Mus., 5, 1931, p. 85.

[2]) Smithsonian Misc. Collns. vol. 76, No. 6, 1923, p. 7, Banka.

plumage, this being indicated at most by a few black patches only. The northern parts of the island are occupied by *Ae. t. viridis* (BP.) which further differs in having the forehead and lores of the males yellower than in other Malaysian races, the extreme development being the extension of the yellow of the forehead over the crown. Females are perhaps a little yellower in general. The southern half of Borneo is inhabited by *Ae. t. damicra* OBERHOLSER (l.c.s.: syn. *Ae. zophonota* OBERH.) a duller bird with a greenish forehead, leading to *Ae. t. scapularis* (HORSF.) of Java, the dullest form of all, in which the sexes are scarcely distinguishable, the males developing no "breeding" plumage. This so-called "breeding" plumage is, in Malaysia, possibly only an extreme adult phase in males.

While the nomenclature of Sumatran-North Malayan birds is not yet final the name I have used for them does indicate their positions more satisfactorily than does calling them all *Ae. t. tiphia*: certainly none of them are *viridis*.

Chloropsis viridis zosterops VIG.

3 ♂, 1 ♀, Wai Lima, Lampongs.
1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).
1 ♀, Talang Betoetoe, Palembang.
1 ♂, Geureudong, Acheen, 900 metres.
1 ♂, Rampah, Acheen.
1 ♀, Aloer Poerba, Acheen.
Wings ♂ 97, 97, 99, 100, 104, 108: ♀ 90, 96, 96 mm.

Chloropsis media (BP.).

1 ♂, 1 ♀, Palembang.
1 ♂, 1 ♀, Korinchi Valley, 900 metres (ROBINSON & KLOSS coll.).
Wings ♂ 97, 101: ♀ 92, 93 mm.

Chloropsis cochinchinensis icterocephala (LESS.).

4 ♂ ad., 1 ♂ imm., 2 ♀, Wai Lima, Lampongs.
1 ♀, Pagar Alam, Palembang, 500—750 metres.
1 ♀, Sumatra.
Wings ♂ 80, 80, 81, 82, 84: ♀ 79, 80, 81, 81 mm.

The young male resembles females, but lacks the golden tint on the nape and the grass-green throat. It is tinged with yellow on the cheeks.

Chloropsis cyanopogon cyanopogon (TEMM.).

1 ♂, 2 ♀, Wai Lima, Lampongs.
1 ♀ Aloer Poerba, Acheen.
Wings ♂ 84: ♀ 75, 75, 79 mm.

Irena puella criniger SHARPE.

1 ♂ imm., Lampongs (VORDERMAN coll.).
2 ♂, 2 ♀, Wai Lima, Lampongs.
1 ♂, Boengamas, Lahat, Palembang.
1 ♀, Geureundong, Acheen.

Wings ♂ 121, 122, 123, 124: ♀ 118, 122, 122 mm.

Only differs from *I. p. turcosa* of Java in having the blue in the males slightly tinged with violet.

Ixos cinereus cinereus (BLYTH).

1 sex inc., Lampongs (VORDERMAN coll.).

1 ♂, 1 ♀, Wai Lima, Lampongs.

Wings ♂ 100: ? 87 imm.: ♀ 94 mm.

Ixos malaccensis malaccensis (BLYTH).

4 ♂, 3 ♀, Wai Lima, Lampongs.

1 ♂, Geureudong, Acheen, 900 metres.

Wings ♂ 103, 105, 105, 107, 110: ♀ 100, 102, 104 mm.

Ixos virescens sumatranus (WARDL.-RAMS.).

1 ♂, Korinchi Valley, 900 metres. (ROBINSON & KLOSS coll.).

2 ♂, 3 ♀, Redelong, Acheen, 1300 metres.

1 ♂, Takengon, Acheen, 1200 metres.

2 ♂, 1 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 93, 93, 94, 94, 96: ♀ 89, 89 mm.

The North Sumatran birds are of a much greener olive, both above and below, and have blacker tails than a series from South and Mid Sumatra collected in 1914—1916; but the topotypes may have undergone postmortem changes while the northern individuals are in fresh plumage having just completed a moult.

Iole olivacea olivacea (BLYTH).

2 ♂, 4 ♀, Wai Lima, Lampongs.

1 ♂, Blangkolam, Acheen,

1 ♂, Aloer Poerba, Acheen.

Wings ♂ 89, 89, 89: ♀ 80, 80, 81, 81 mm.

I find it impossible to distinguish between Sumatran and Malayan examples, but OBERHOLSER, who has separated the bird of the Anamba Islands as *crypta*, states that the Sumatran bird should also bear that name (Proc. Biol. Soc. Wash. 31, 1918, p. 197).

The genus *Iole* should probably be merged in *Ixos*.

Brachypodius atriceps atriceps (TEMM.).

2 ♂, 3 ♀, Wai Lima, Lampongs.

1 ♂, Aoer, Lahat, Palembang.. (STRASTERS coll.).

1 ♂, 1 ♀, Pagar Alam, Palembang, 500—750 metres. (OUWENS coll.).

1 ♀, Pontian near Palembang Town. (STRASTERS coll.).

1 ♀, Kajoetanam, Priaman, Sumatra's Westkust.

Wings ♂ 74, 76, 76, 78: ♀ 73, 73, 74, 75, 75, 76 mm.

Criniger tephrogenys tephrogenys (JARD. & SELBY).

4 ♂, 2 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀, Aloer Poerba, Acheen.

Wings ♂ 100, 100, 101, 102, 105: ♀ 92, 97, 99 mm.

Criniger tephrogenys sumatranus WARDL.-RAMS.

1 ♀, 1 sex inc., Palembang.

1 ♀, Pagar Alam, Palembang, 500—750 metres.

1 ♂, Geureudang, Acheen, 900 metres.

Wings ♂ 122: ♀, 112: ? 112 mm.

A darker form than the last with the white throat more extentive.

Tricholestes criniger sericea (S. MÜLL.).

2 ♂, 2 ♀, Wai Lima, Lampongs.

Wings ♂ 78, 79: 71, 72 mm.

A series with very bright yellow underparts.

Trachycomus zeylanicus (GM.).

Trachycomus ochrocephalus AUCT.

1 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, 2 ♀, Palembang. (OUWENS coll.).

2 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

1 ♀, Medan, N. E. Sumatra.

1 ♂, Isaq, Acheen, 1000 metres.

2 ♂, 1 ♀, Blangkolam, Acheen.

Wings ♂ 119, 120, 120, 120, 121, 122: ♀ 115, 116, 119, 122, 123 mm.

A young male (wing 113) has the crown albescent.

Pycnonotus goiaver personatus HUME.

Pycnonotus analis AUCT.

1 ♂, Wai Lima, Lampongs.

1 ♂ 1 ♀, Palembang.

1 ♂, Pontian near Palembang Town.

1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

2 ♀, Medan, N. E. Sumatra.

1 ♂, Isaq, Acheen, 1000 metres.

2 ♀, Blangkolam, Acheen.

Wings ♂ 83, 85, 89, 90, 92: ♀ 81, 86, 89, 89 mm.

This race is distinguished by the very white superciliaries and ear-coverts. It extends to the Malay Peninsula.

Pycnonotus plumosus subsp.

1 ♂, Talang betoetoe, Palembang.

Wing 83 mm.

The Olive Bulbul of Sumatra is inseparable on size and colour from the typical Malayan bird: but it occurs in two forms. Along the east side of the

island where it has the irides brown or red it is *Pycnonotus plumosus plumosus.* Along the west side (and on the neighbouring islands) the irides are yellow or orange: and to this form I propose to attach the name *Pycnonotus inornatus* BONAPARTE, with terra typica Padang, as the type in Leyden is more likely to have come from that neighbourhood than from Eastern Sumatra. RILEY (Proc. U. S. Nat. Mus., 75, art. 4, 1929, p. 27) has suggested that examination of the type would settle the question. It is improbable, however, that any record of the colour of the irides was made.

Pycnonotus brunneus brunneus BLYTH.

1 ♀, Palembang.

1 ♀, Pontian, near Palembang Town, "eyes light red" (STRASTERS coll.).

1 ♂, Aoer, Lahat, Palembang, "eyes red-brown" (STRASTERS coll.).

1 sex inc., Benkoelen.

2 ♂, 3 ♀, Wai Lima, Lampongs.

Wings ♂ 84, 85, 89: ? 85: ♀ 79, 79, 80, 82, 84 mm.

Pycnonotus simplex simplex (LESS.).

1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

Wing 80 mm. "Iris cream white".

Pycnonotus erythropthalmos erythrophthalmos (HUME).

Pycnonotus erythropthalmos cyanochrus OBERH. (Sumatra).

1 ♂, Pontian, near Palembang Town. (STRASTERS coll.).

2 ♂, 1 ♀ Aloer Poerba, Acheen.

2 ♂ ad., 1 imm., 1 juv., 2 ♀ ad., Wai Lima, Lampongs.

Wings ♂ 75, 75, 75, 76, 76, 71 imm., 71 juv.: ♀ 72, 73, 73 mm.

The young birds are without the olivaceous tinge of the adults, being brown above and one is washed with the same colour on the breast and flanks.

I cannot separate Sumatran from continental birds.

Pycnonotus bimaculatus barat ROBINSON & KLOSS.

1 ♀, Palembang.

1 sex inc., Pagar Alam, Palembang, 500—750 metres.

1 ♂, Korinchi Valley, 900 metres (ROBINSON & KLOSS coll.).

Wings ♂ 90: ? 89: ♀ 87. Tail ♂ 102: ? 100: ♀ 100 mm.

Pycnonotus bimaculatus snouckaerti SIEBERS (Plate 4).

Pycnonotus bimaculatus barat VAN HEURN and SNOUCKAERT VAN SCHAUBURG, 1921; SNOUCKAERT, 1922.

Pycnonotus snouckaerti SIEBERS, Treubia, X, 1928, p. 395 (Takengon Lake, Acheen).

1 ♂, 1 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

1 ♂, Pangmoh, Acheen, 2000 metres.

Wings ♂ 98, 99: ♀ 93. Tail ♂ 106, 110: ♀ 101 mm.

While *P. b. barat* ROB. & KLOSS, of West Java and Sumatra (northwards at least as far as Lake Toba) [1]) only differs from the typical bird of East Java in having the ear coverts more extensively and deeply yellow, the upper parts more olive and the throat paler (vide plate 4), the Achinese race is very distinct. It is rather larger, has the upper surface blacker and much less olive, no yellow on the cheeks, the orange frontal patches larger but not reaching the eye; only the middle of the lower abdomen whitish, the rest of the underparts fuscous edged with whitish; and the centres of the under tail-coverts olive. The edge of the wing and the under wing-coverts are fuscous, not yellow and whitish respectively.

The examples figured in plate 4 are from Tamansari, near Banjoewangi, East Java (*P. b. bimaculatus* ♂); from Korinchi Valley, Central Sumatra (*P. b. barat* ♂) and from Acheen, North Sumatra (*P. b. snouckaerti* ♂).

Pycnonotus cyaniventris cyaniventris BLYTH.

1 ♂, 1 ♀, Wai Lima, Lampongs.
1 ♂, Aloer Poerba, Acheen.
Wings ♂ 74, 77: ♀ 73 mm.

Pycnonotus aurigaster aurigaster (VIEILL.).

Pycnonotus aurigaster martini PARROT (Sumatra).
1 sex inc., Medan, N. E. Sumatra.
Wing 97 mm.
We believe this to be a species introduced from Java.

Rubigula dispar dispar (HORSF.).

1 ♂, 3 ♀, Wai Lima, Lampongs.
1 ♂, Palembang.
2 ♂, Poentian, near Palembang Town. (STRASTERS).
2 ♂, Pagar Alam, Palembang, 500—750 metres.
2 sex inc., Benkoelen. (VORDERMAN coll.).
Wings ♂ 80, 80, 82, 83, 84, 84: ? 82, 85: ♀ 81, 82, 83 mm.

Rubigula squamata webberi (HUME).

2 ♂, 1 ♀, Wai Lima, Lampongs.
Wings ♂ 71 (moult), 78: ♀ 73 mm.

TIMALIIDAE.

Eupetes macrocercus macrocercus (TEMM.).

1 sex inc., Lampongs (VORDERMAN coll.).
Wing 99 mm.

[1]) Journ. Straits Branch, R. A. S., No. 81, 1920, p. 103.

Pycnonotus bimaculatus bimaculatus, ♂ (Top); *P. b. barat*, ♂ (Middle); *P. b. snouckaerti*, ♂ (Bottom).

Garrulax leucolophus bicolor S. MÜLL. in HARTL.

1 ♂, Korinchi Valley, 900 metres (ROBINSON & KLOSS coll.).

1 ♀, Tabat Patah, Pajakombo, Sumatra's Westkust. (GROENEVELD coll.).

1 sex inc., Sumatra.

1 ♂, 4 ♀ Redelong, Acheen, 1300 metres.

Wings ♂ 128, 129: ? 130: ♀ 119, 122, 125, 127, 129 mm.

It would appear that in Museum skins the colour seems to change rapidly from brownish black to chocolate brown.

Garrulax palliatus palliatus (BP.).

1 ♀, Sungei Kumbang, Korinchi Peak, 1400 metres (ROBINSON and KLOSS coll).

1 ♂, Redelong, Acheen, 1300 metres.

Wings ♂ 133: ♀ 118 mm.

In this bird the extent of the brown wash on the flanks and black on the chin is variable. In old skins the brown areas seem to become more saturate.

Melanocichla lugubris lugubris (S. MÜLL.).

1 ♀, Pagar Alam, Palembang.

1 ♂, Pintu ? (OUWENS coll.).

Wings ♂ 122: ♀ 127 mm.

Rhinocichla mitrata mitrata (S. MÜLL.).

1 ♂, 1 ♀, Palembang.

1 ♂, 1 ♀, Pagar Alam, Palembang, 500—750 metres.

1 sex inc. Djambi River, E. Sumatra.

1 ♂, Palembajan, Sumatra's Westkust (OUWENS coll.).

1 ♀, Batoe Gedang, Sumatra's Westkust (OUWENS coll.).

1 ♂, Fort de Kock, Sumatra's Westkust, 900 metres. (GROENEVELD coll.).

1 ♀, Isaq, Acheen, 1000 metres.

2 ♂, 4 ♀, Redelong, Acheen, 1300 metres.

Wings ♂ 92, 97, 101, 101, 105, 107: ? 92: ♀ 97, 99, 100, 100, 103, 103, 105, 105 mm.

Malacocincla sepiaria subsp.

1 sex inc., Lampongs. (VORDERMAN coll.).

Wing 73 mm.

It is now impossible to say to which of the subspecies occurring in Sumatra this bird belongs — *tardinata* HARTERT, or *barussana* ROB. & KLOSS.

Turdinus rufipectus SALV.

1 ♂, Sungei Kumbang, Korinchi Peak, 1400 metres. (ROBINSON and KLOSS coll.).

Wing 88 mm.

Erythrocichla bicolor (LESS.).

1 sex inc., Lampongs. (VORDERMAN coll.).

Wing 74 mm.

Pellorneum capistratum nigrocapitatum (EYTON).

1 sex inc., Aloer Poerba, Acheen.

Wing 74 mm.

OBERHOLSER has separated the Banka bird (*Drymocataphus n. nyctilampis*, Smithsonian Misc. Coll. 72. No. 2, 1922, p. 10) as being duller and darker above than Malayan examples and considers that Sumatran birds agree with it.

Aethostoma pyrrogenys büttikoferi (VORDERMAN).

1 ♂, Wai Lima, Lampongs.

Wing 67 mm.

A very dull coloured race of *Myiothera pyrrogenys* TEMM., having the crown concolorous with the back. The Bornean form, *Turdinus canicapillus* SHARPE, is the most richly coloured, especially on the underparts, and has the most pronounced dark cap.

Two forms occur in Java, the western bird being well fitted by TEMMINCK's figure and description. The eastern bird is rather more richly coloured; the cap darker and more distinct; the forehead with less fulvous; the cheeks and sides of neck and breast more deeply ferruginous.

This form from East Java I would call

Aethostoma pyrrogenys besuki subsp. nov.

Type: Adult female collected at Tamansari, near Banjoewangi, East Java, 1600 ft. on 20th January 1920 by C. BODEN KLOSS. Wing 60 mm.

The type locality of the typical race may be restricted to the West Javanese province of Bantam.

This treatment gives us four races of *Aethostoma pyrrogenys*, as follows:—

I. *Ae. p. canicapillus*	Borneo the most richly coloured form with a pronounced dark cap and fulvous under tail-coverts.
II. *Ae. p. besuki*	East Java. Cap paler, underparts less washed with brown: under tail-coverts white.
III. *Ae. p. pyrrogenys*	West Java. Crown merely duller than back, forehead more fulvous, cheeks and sides of neck less brilliant rufous.
IV. *Ae. p. büttikoferi*	Sumatra. The dullest form, olivaceous-brown above with cap of the same colour, no bright colour on sides of neck or underparts.

A fifth race of *Aethostoma pyrrogenys* is *A. p. erythrote* (*Malacopteron erythrote* SHARPE, Cat. Birds, VII, 1883, p. 567, pl. XIII, fig. 2). The type is in the British Museum and Mr. N. B. KINNEAR writes me that as compared with the West Javan bird it has the back and wings distinctly lighter in colour, the cheeks redder and the pectoral band more distinct. He gives the following measurements:— Wing 68, tail 50, bill from base of skull 18, width at front of feathers at posterior end of nostrils 6.5 mm.

Mr. F. N. Chasen who has compared the type of *erythrote* with the East Javanese bird says that the former is paler and brighter above with the pectoral band more complete.

Malacopteron erythrote was reported to have come from Borneo, though Sharpe later doubted this derivation. The type is still unique and the provenance attributed to it had better remain for the present.

Malacopteron cinereum cinereum Eyton.

1 sex inc., Lampongs. (Vorderman coll.).

2 ♂, Wai Lima, Lampongs.

Wings ♂ 78, 79: ? 74 mm.

I am of opinion that *Malacopteron rufifrons* Cab. of Java (syn. *M. lepidocephalum* Gray) and the closely allied form *indochinensis* Rob. and Kloss, of East Siam and Cochin China, are only races of *M. cinereum* and do not form a separate species, for the occurrence of a *rufifrons* form in Sumatra is more than doubtful. The section of the species having a black patch on occiput and nape occurs in Sumatra, the Malay Peninsula and Borneo, that in which the dark patch is absent in Java and Indo-China.

Malacopteron magnirostris magnirostris (Moore).

2 sex inc., Lampongs. (Vorderman coll.).

5 ♂, 2 ♀, Wai Lima, Lampongs.

Wings ♂ 75, 76, 78, 84: ? 77, 79: ♀ 74, 75 mm.

A young male (wing 72 mm) has numerous rufous feathers on the back and wings and the underparts washed with earthy brown.

Anuropsis malaccensis malaccensis (Hartl.).

1 ♂, Loeboek Karet, ? Palembang.

1 ♂, Blangkolam, Acheen.

1 ♂ Aloer Poerba, Acheen.

Wing 66, 69, 72 mm.

The Sumatran bird has been named *A. m. drymodrama* by Oberholser (Smiths. Misc. Collns., 74, No. 2, 1922, p. 9, Siak). I cannot separate from topotypes the examples I have seen from the island.

Alcippe cinerea cinerea Blyth.

2 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, Aloer Poerba, Acheen.

Wings ♂ 68, 69, 71: ♀ 68 mm.

Stachyris nigriceps larvata (Bp.).

1 ♂, Redelong, Acheen, 1300 metres.

Wing 59 mm.

Stachyris poliocephala poliocephala (TEMM.).

1 ♂, Wai Lima, Lampongs.

1 ♂, Geureudong, Acheen, 900 metres.

Wing 66, 66 mm.

The Achinese specimen has an unusually dark nape and mantle.

In Ibis, 1918 (p. 587) ROBINSON and KLOSS, with examples before them of *S. poliocephala* from Deli, N. E. Sumatra, separated Malayan and Bornean birds, with the name *S. p. diluta,* principally on account of the paler, less black, throat and sides of the head.

They concluded that the examples from Deli were typical of all Sumatran birds, but the specimen from the Lampongs shows that this is not the case. As with *Thringorhina striolata* it would seem that the darker birds are restricted to N. E. Sumatra [1]) and that it is the paler, not the darker, form that is the typical one (head, cheeks and throat pale grey). I propose therefore to treat *P. s. diluta* as synonymous with *S. p. poliocephala* which occurs, as TEMMINCK states, in Sumatra and Borneo (and in the Malay Peninsula as well) and to distinguish the bird of N. E. Sumatra as

Stachyris poliocephala pulla subsp. nov.

Stachyris poliocephala ROBINSON and KLOSS, Journ. Straits Branch, Roy. Asiat. Soc., No. 80, 1919, p. 117; id., op. cit., No. 81, 1920, p. 105.

Like the typical form but with the sides of the head, chin and throat blackish grey instead of pale grey ("gris cendre", TEMMINCK).

Type. Adult male collected at Toentoengan, Deli, N. E. Sumatra on 17 December, 1918 by A. C. F. A. VAN HEYST.

One male and four females examined.

Wings ♂ 71: ♀ 67, 67, 68, 69 mm.

Compared with one specimen from the Lampongs, another from North Acheen, and with large series from the Malay Peninsula and Borneo which both show a little individual variation in the brown colour of the body.

I restrict the type locality of *Timalia poliocephala* TEMM., to Benkoelen, as birds seen by TEMMINCK must all have come from south of the equator.

Stachyris maculata maculata (TEMM.).

1 ♂, 1 ♀, Rampah, Acheen.

1 ♂, Aloer Poerba, Acheen.

Wings ♂ 85, 85: ♀ 79 mm.

Stachyris chrysaea bocagei (SALV.).

2 ♂, Isaq, Acheen, 1000 metres.

1 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

1 ♀, Takengon, Acheen, 1200 metres.

Wings ♂ 52, 57: ♀ 52, 56 mm.

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[1]) *Thringorhina striolata umbrosa* KLOSS, Journ. Fed. Malay States Mus., X, 1921, p. 212. Deli, N. E. Sumatra.

Thringorhina striolata striolata (S. Müll.).

1 ♂, Sungei Kumbang, Korinchi Peak, 1400 metres (Robinson & Kloss. coll.).

Wing 70 mm.

This is a darker bird than the continental *T. s. guttata* (Blyth). A yet darker form, *T. s. umbrosa* Kloss, occurs in Deli, N. E. Sumatra, to which part of the island it is apparently confined.

Cyanoderma erythroptera erythroptera Blyth.

1 sex inc., Lampongs. (Vorderman coll.).

2 ♂, 1 ♀, Wai Lima, Lampongs.

Wings ♂ 60, 60: ? 56: ♀ 56 mm.

Not separable from Malayan topotypes in which the colours of breast and abdomen exhibit individual variation.

Cyanoderma erythroptera pyrrhophaea (Hartl.).

Robinson & Kloss Journ. Straits Branch Royal Asiatic Soc., No. 81, 1920, p. 106.

1 ♀, Aloer Poerba, Acheen.

Wing 60 mm.

Differs from the Malayan form (also occurring in South Sumatra) in being darker above, the head more extensively grey; and the abdomen less washed with isabelline than in many typical birds, though in this respect closely approached by others.

In 1920 (l.c.s.) we used *pyrrophaea* Hartl. (Rev. Zool., 1844, p. 402, Malacca, Sumatra) for a similar dark North Sumatran bird citing Sumatra as type locality as the description ("Capite ... saturate murinis") applied to it and not to Malayan examples.

Oberholser's selection of Malacca in 1922 comes too late and his *C. erythroptera eripella* (Smithsonian Misc. Coll., 74, No. 2, 1922, p. 7, Siak, East Central Sumatra) appears to be a synonym of *pyrrhophaea.*

This form seems to be confined to the northern half of the island.

Mixornis gularis gularis (Horsf.).

2 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, Poentian near Palembang Town. (Strasters coll.).

1 ♀, Medan, N. E. Sumatra.

1 ♀, Blangkolam, Acheen.

1 ♂, Aloer Poerba, Acheen.

Wings ♂ 53, 57, 60, 60: ♀ 55, 58, 58 mm.

Macronus ptilosus ptilosus Jard. & Selby.

1 sex inc., Lampongs. (Vorderman coll.).

1 ♂, Aloer Poerba, Acheen.

Wings ♂ 75: ? 67 mm.

Myiophoneus flavirostris dicrorhynchus SALV.

1 sex inc., Boemi agoeng, Lampongs.

Wing 185 mm.

Myiophoneus castaneus WARDL.-RAMS.

1 ♂, Takengon, Acheen, 1200 metres.

Wing 132 mm.

A young bird generally chestnut with blue shoulder patches, the head dark brown slightly tinged with blue from crown to nape.

Myiophoneus melanurus (SALV.).

2 ♂, Palembang.

1 ♂, 1 ♀, Korinchi Peak, 2200 metres. (ROBINSON & KLOSS coll.).

1 ♂, 1 ♂ imm., 3 ♀, Redelong, Acheen, 1300 metres.

1 ♂, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

1 ♂, Isaq, Acheen, 1000 metres.

1 ♂ imm., Takengon, Acheen, 1200 metres.

Wings ♂ 125, 125, 128, 127, 129, 131, 122 imm., 125 imm.: ♀ 112, 114, 119, 120 mm.

Young males are less blue on the forehead where, and on the underparts, they are spotted with buff.

Brachypteryx montana saturata SALV.

1 ♂, Korinchi Peak, 2200 metres. (ROBINSON & KLOSS coll.).

1 ♂, 1 ♀, Pajatoengkalan, Acheen, 2000 metres.

Wing ♂ 69, 70: ♀ 69 mm.

Brachypteryx leucophris leucophris (TEMM.).

1 ♂, Sungei Kumbang, Korinchi, 1400 metres. (ROB. & KLOSS coll.).

Wing 60 mm.

Sibia picaoides simillima (SALV.).

1 ♂, Sungei Kumbang, Korinchi, 1400 metres. (ROB. & KLOSS coll.).

1 ♂, 2 ♀, Redelong, Acheen, 1300 metres.

2 ♂, Pajatoengkalan, Acheen, 2000 metres.

1 ♂, 1 ♀, Isaq, Acheen, 1000 metres.

Wings ♂ 112, 115, 117, 117, 118: ♀ 115 mm.

Mesia argentauris laurinae (SALV.).

1 ♂, 1 ♀, Korinchi Peak, 1400—2200 metres. (ROB. & KLOSS coll.).

6 ♂, 3 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

1 ♀, Redelong, Acheen, 1300 metres.

Wings ♂ 79, 80, 80, 82, 82, 82, 82: ♀ 77, 79, 79, 80, 81 mm.

Pteruthius flaviscapis cameranoi SALV.

1 ♂, Korinchi Peak, 2200 metres. (ROBINSON & KLOSS coll.).

1 ♂, 1 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 74, 79: ♀ 77 mm.

Pteruthius aenobarbus aenobarbus (TEMM.).

1 ♂, Lampongs. (VORDERMAN coll.).

Wing 67 mm.

TROGLODYTIDAE.

Pnoepyga pusilla lepida SALV.

1 ♂, 1 ♀, Korinchi Peak, 1400—2200 metres. (ROBINSON and KLOSS coll.).

1 ♀, Isaq, Acheen, 1000 metres.

1 ♂ Redelong, Acheen, 1300 metres.

Wings ♂ 50, 52: ♀ 51, 51 mm.

TURDIDAE.

Geocichla sibirica (?) ṣibirica (PALL.).

2 ♂ imm., Wai Lima, Lampongs. 19 Nov. and 5 Dec. 1921.

Wings 115, 119 mm.

One cannot with any satisfaction allocate immature males to one or other of the two forms of this species which seem to visit Malaysia. Of slate-coloured males which have no pale spots on the breast we refer to the typical form those examples which have slaty abdomens and very little white on the under-tail coverts and the tip of the tail: to *davisoni* those with an elongate white patch on the abdomen and a considerable amount of white on the tail-coverts and tail-tip. We have the former from the mountains of Java (east and west) and from the islands of the Straits of Malacca: the latter from the mountains of the Malay Peninsula and of Central Sumatra. BARTELS and STRESEMANN (Treubia XI, 1929, p. 130) record *sibirica* and suggest that *davisoni* appears to visit Java: and on account of the amount of white on the tail-coverts and tail-tips of the present specimens from the Lampongs I am inclined to think that the typical *sibirica* occurs in Sumatra as well as *davisoni*.

Females and immature birds associated with the adult males appear to agree with them in the lesser or greater amount of white in the tail and its under coverts.

Enicurus ruficapillus TEMM.

1 ♂, Wai Lima, Lampongs.

Wing 93 mm.

Copsychus saularis musicus (RAFFLES).

1 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀ imm., Palembang.

1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

1 ♂, Pangkalan Koto Baroe, Sumatra's West Coast (STRASTERS coll.).

3 ♂, 1 ♀ imm., Medan, N. E. Sumatra.

1 ♀, Isaq, Acheen, 1000 metres.

1 ♂, Baleq, Acheen, 900 metres.

Wings ♂ 101, 101, 102, 102, 104, 105, 106: ♀ 93 imm., 95, 97, 98 mm.

Kittacincla malabarica tricolor (VIEILL.).

2 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀, Palembang.

1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

1 ♂, 1 ♀, Baleq, Acheen, 900 metres.

1 ♂, Blangkolam, Acheen.

1 ♂, Rampah, Acheen.

3 ♂, 1 ♀, imm., Aloer Poerba, Acheen.

Wings ♂ 94, 95, 96, 96, 96, 97, 97, 99: ♀ 88, 88, 89 mm.

I cannot separate this series from birds of West Java (*tricolor*). Compared with Malayan and Indochinese females Sumatran birds of that sex have the upper parts and the foreneck darker, blackish, with a metallic sheen; the breast and flanks generally more deeply rufescent. These are the characters OBERHOLSER has used to separate the bird of Singkep Island, East Sumatra, from the continental form [1]); but he did not compare it with the West Javanese race. He states that the Singkep bird apparently inhabits the mainland of Sumatra and its eastern islands except Banka and Billiton: to the Banka bird he has given the name *K. m. abbotti* (l.c.s.). Be it noted, however, FINSCH states that birds from West Java, Sumatra, Banka and Billiton all agree perfectly. (Notes Leyden Mus., XXXII, 1910, p. 145).

Trichixus pyrropyga LESS.

1 ♀, Langkat, N. E. Sumatra.

Wing 97 mm.

SYLVIIDAE.

Acrocephalus stentoreus orientalis (TEMM. & SCHL.).

1 ♂, Lampongs.

Wing 77 mm.

Locustella certhiola (PALL.).

1 sex inc., subad., Lampongs.

Wing 67 mm.

Cettia montana sepiaria subsp. nov.

2 ♂, 3 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 55, 56: ♀ 52, 52, 53 mm.

Much darker and duller than *C. m. sumatranus* OGILVIE-GRANT, which occurs throughout Sumatra at least as far north as Mt. Talamau, Ophir Districts. More nearly resembling *C. m. oreophila* SHARPE, of Mt. Kinabalu, North Borneo, but still darker and duller above where it is sepia (RIDGWAY).

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[1]) *Kittacincla malabarica mallopercna* Oberh., Smithsonian Misc. Coll., 76, No. 6, 1923, p. 5, Singkep Island.

Of the Malaysian forms the typical race is the palest, near "Dresden Brown"; *sumatrana* is brightest, near "Raw Umber"; *oreophila* is very like *sumatrana* above, but duller, less rufous below; *sepiaria* is darkest and dullest above, but very similar to *oreophila* beneath.

Type. Adult male collected at Pajatoengkalan, Pangmoh, Acheen, 2000 metres on 11th Sept. 1930, No. 293.

The above series has been compared with good series of each of the other races. All these Malaysian examples have the outer tailfeathers falling short of the tip of the tail by much less than the length of the tarsus. BARTELS and STRESEMANN have recently placed the Javanese race in *Horeites*.

Orthotomus atrogularis atrogularis TEMM.

1 ♂, Aloer Poerba, Acheen.

Wing 47 mm.

OBERHOLSER has separated the bird of Banka Island as *O. a. eumelas* (Smithsonian Misc. Collns., 76, No. 6, 1923, p. 6) and suggests that it is the form occurring in Sumatra.

Orthotomus ruficeps ruficeps (LESS.).

2 ♂, Wai Lima, Lampongs.

Wings 51, 53 mm.

Orthotomus sepium cineraceus BLYTH.

2 ♂, 2 ♀, Wai Lima, Lampongs.

1 ♂, Medan, N. E. Sumatra.

Wings ♂ 47, 50, 50: ♀ 44, 45 mm.

Cisticola juncidis malaya LYNES.

Ibis, 1930, p. 92 (Selangor, Malay Peninsula).

1 ♂, Wai Lima, Lampongs.

1 ♀, Poentian, near Palembang Town. (STRASTERS coll.).

Wings ♂ 52: ♀ 47 mm.

Phylloscopus borealis borealis (BLAS.).

1 ♀, Wai Lima, Lampongs.

Wing 65 mm.

Phylloscopus occipitalis coronatus (TEMM. & SCHL.).

1 ♂, 1 ♀, Wai Lima, Lampongs.

Wings ♂ 62: ♀ 60 mm,

Apparently a new record for Sumatra.

Phyllergates cucullatus (?) sumatranus SALV.

1 ♂, Isaq, Acheen, 1000 metres.

1 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

1 ♂, Redelong, Acheen, 1300 metres.

Wings ♂ 46, 48: ♀ 48 mm.

I am doubtful if characters to distinguish this race have any real existence. The nuchal collar is perhaps greyer, rather less tinged with brown than in the typical Javanese bird. The type was an immature individual with a green pileum.

Suya superciliaris albogularis (HUME).

2 ♂, Takengon, Acheen, 1200 metres.

Wings 52, 53 mm.

Prinia familiaris olivacea RAFFLES

Motacilla olivacea RAFFLES, Trans. Linn. Soc., XIII, 1821, p. 313, Sumatra.

1 ♂, 1 ♀, Wai Lima, Lampongs.

Wings ♂ 67: ♀ 65 mm.

Prinia familiaris (HORSF.) came from Java and was described in 1820: a little later RAFFLES named the Sumatran bird which, with West Javan birds, differs from those of East Java in having the abdomen a rather brighter yellow. By elimination, therefore, East Java becomes the type locality of *Prinia f. familiaris*: and it is here further restricted to the province of Besoeki where HORSFIELD did much of his collecting.

Prinia flaviventris rafflesi TWEED.

Prinia rafflesi TWEEDDALE, Ibis, 1877, p. 311, pl. VI, fig. 1. Lampongs, South Sumatra.

1 ♂, Wai Lima, Lampongs.

1 sex inc., Medan, N. E. Sumatra.

Wings ♂ 47: ? 48 mm.

The type locality of *Orthotomus flaviventris* DELESS., is Bhutan. My colleague, Mr. F. N. CHASEN, after examining the considerable series in the British Museum, informs me that southern birds have the abdomen paler yellow than northern ones. Malayan, Sumatran and Javanese birds will, therefore, have to be known by the above name.

LANIIDAE.

Hemipus hirundinaceus (TEMM.).

Hemipus obscurus (HORSF. & AUCT.).

7 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♀, Poentian near Palembang Town. (STRASTERS coll.).

1 ♀, Pangkalan Koto Baroe, Sumatra's Westkust. (STRASTERS coll.).

1 ♀, Aloer Poerba, Acheen.

Wings ♂ 64, 65, 65, 66, 66, 68, 68: ♀ 63, 65, 65, 67 mm.

Hemipus picatus SYKES.

1 ♀, Palembang.

1 ♀, Geureudang, Acheen, 900 metres.

Wings 64, 65 mm.

Tephrodornis gularis gularis (RAFFLES).

1 ♂, 2 ♀, Wai Lima, Lampongs.

Wings ♂ 87: ♀ 90, 92 mm.

This is the smallest form of the species. In Sumatra it seems to be confined to the lower levels of the south-west parts of the island: it occurs also in Java (syn. *virgatus* TEMM.).

Tephrodornis gularis fretensis ROB. & KLOSS.

1 ♂, 1 ♀, Palembang.

Wings ♂ 106: ♀ 106 mm.

This subspecies inhabits Sumatra except in the area occupied by the smaller typical race. It occurs also throughout the southern parts of the Malay Peninsula.

Platylophus galericulatus coronatus (RAFFLES).

1 sex inc., Lampongs (VORDERMAN coll.).

1 ♂, Wai Lima, Lampongs.

1 sex inc., Palembang.

2 ♂, 1 sex inc., Pagar Alam, Palembang, 500—750 metres.

Wings ♂ 133, 134, 134: ? 127, 130, 138 mm.

Lanius schach bentet HORSF.

1 ♂, Boekit Gadang, Sumatra's Westkust.

1 ♀, Palembang.

1 ♀, Palembajan, Sumatra's Westkust (OUWENS coll.).

1 ♀, Wai Lima, Lampongs.

1 ♀, Fort van der Capellen, Sumatra's Westkust, 500—750 metres (GROENEVELD coll.).

1 ♀, Isaq, Acheen, 1000 metres.

1 ♀, Takengon, Acheen, 1200 metres.

Wings ♂ 88: ♀ 87, 88, 89, 90, 90, 94 mm.

The amount of black on the forehead and crown of this race is variable and KURODA has recently named *L. s. tosariensis* (Tori, V, 1930, 76. Tosari, Java) what seem to me to be merely extremely black-headed examples of *bentet*. OGILVIE-GRANT has drawn attention to the varying amount of black on the head of Javanese birds (Nov. Zool. IX, 1902, p. 478).

Lanius tigrinus DRAP.

1 sex inc., Lampongs (VORDERMAN coll.).

1 ♂, 1 ♀, Wai Lima, Lampongs.

3 ♂, Talang Betoetoe, Palembang.

1 ♂, Rampah, Acheen.

1 ♀, Aloer Poerba, Acheen.

Wings ♂ 79, 80, 82, 83, 85: ? 82: ♀ 83, 86 mm

Lanius cristatus (?) cristatus LINN.

1 sex inc., Lampongs (VORDERMAN coll.).

1 ♂, 1 ♀, Wai Lima, Lampongs.

Wings ♂ 86: ? 92: ♀ 88 mm.

Mr. H. C. SIEBERS has determined these birds as *lucionensis* LINN., but though the typical form does not seem to have been recorded from Sumatra or Java, it is the commonest of the three races in the Malay Peninsula and I am inclined to refer the specimens to it. They are more brightly coloured above than other Malaysian skins which we consider to be *lucionensis*.

Lanius cristatus superciliosus LATH.

1 ♂, Wai Lima, Lampongs.

Wing 87 mm.

An example in very worn and faded plumage taken in December. Patches of bright rufous-cinnamon feathers are still present.

PARIDAE.

Parus major ambiguus (RAFFLES).

Turdus ambiguus RAFFLES, Trans. Linn. Soc. XIII, 1822, p. 311. Sumatra.

Parus major malayorum ROB. & KLOSS, Journ. Fed. Malay States Mus., VIII, Part 2, 1918, p. 226. Korinchi.

1 ♀, Isaq, Acheen, 1000 metres.

1 ♀, Baleq, Acheen, 900 metres.

Wings 62, 63 mm.

SITTIDAE.

Sitta frontalis frontalis (SWAINSON).

2 ♂, Wai Lima, Lampongs.

1 ♂, Palembang.

Wings 74, 77, 77 mm.

Not separable from Javanese birds, a series of which has wings ranging from 71 to 81 mm in length. In Sumatra apparently confined to the south. PARROT's *S. f. hageni* for Banka, based on the presumed large size of a single example (wing 77.5 mm) will not stand.

Sitta frontalis saturatior HART.

1 ♀, Isaq, Acheen, 1000 metres.

1 ♂, Geureudong, Acheen, 900 metres.

Wings ♂ 73: ♀ 75 mm.

This race, described from the Malay States, is more deeply coloured (more vinous) below than the typical form which is not only found in Java and South Sumatra, but in Indochina as well. The specimen from the West Coast of Sumatra in the latitude of Korinchi recorded as *S. frontalis* by ROBINSON & KLOSS (Journ. Fed. Malay States Mus., VIII, Part 2, 1918, p. 227) also

belongs to this form which, therefore, seems to inhabit the centre as well as the north of Sumatra.

Sitta azurea expectata (Hartert).

♂, Isaq, Acheen, 1000 metres.

♂, ♀, Takengon, Acheen, 1200 metres.

♂, Tlaga, Redelong, Acheen, 1700 metres.

Wings ♂ 80, 81, 82: ♀ 80 mm.

The West Javanese race, *S. a. nigriventer* Rob. & Kloss, has much less blue on the wings and is more washed with buff on the foreneck and breast. Both *expectata* and *nigriventer* differ from the typical form of East Java (in which the wings are as in *nigriventer*) in having the abdomen black instead of dark blue.

CORVIDAE.

Platysmurus leucopterus leucopterus (Temm.).

1 sex inc., Lampongs (Vorderman coll.).

1 ♂, Djepara, Lampongs. (Tans coll.).

1 sex inc., Palembang.

1 ♂, Poentian near Palembang Town. (Strasters coll.).

1 ♂, Aoer, Lahat, Palembang. (Strasters coll.).

1 ♀, Talang Betoetoe, Palembang.

1 ♂, 1 ♀, Pangkalan Koto Baroe, Sumatra's West Coast (Strasters coll.).

Wings ♂ 184, 185, 189, 189, 191: ? 191: ♀ 182 mm.

Cissa chinensis minor (Cab.).

1 ♀, Boemi agoeng, Lampongs.

1 ♀, Pagar Alam, Palembang, 500—750 metres.

1 ♂, 2 ♀, Palembang.

Wings ♂ 130: ♀ 125, 126, 127, 131 mm.

Dendrocitta occipitalis occipitalis (S. Müll.).

1 ♀, Palembang.

3 ♀, Peloempang, Sumatra's Westkust.

1 ♀, Palembajan, Sumatra's Westkust. (Ouwens coll.).

1 ♀, Tabat Palah, Pajokomboe, Sumatra's Westkust. (Groeneveld coll).

2 sex inc., Palembang.

1 ♂, Goenoeng Agoeng, ?.

1 ♀, Korinchi Valley, 720 metres (Robinson & Kloss coll.).

1 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

1 ♀, Tlaga, Redelong, Acheen, 1700 metres.

1 ♀, Redelong, Acheen, 1300 metres.

Wings ♂ 142: ? 140, 144: ♀ 130, 130, 134, 137, 137, 138, 140, 140, 145, 151 mm.

The last measurement, that of the female from Pajatoengkalan, seems to be unusually large.

The brown areas in the older skins are much more rufous than in the recently collected Achinese birds. I regard the difference as due to postmortem changes.

DICRURIDAE.

Dicrurus leucophaeus phaedra (REICHN.).

Buchanga leucophaea batakensis ROBINSON & KLOSS, Journ. Straits Br. Roy. Asiat. Soc., No. 80, 1919, p. 125. N. E. Sumatra.

1 ♀, Palembang.

1 ♀, juv. Redelong, Acheen, 1300 metres.

Wings 121, 123 (juv.) mm.

The young bird is darker than the adult and has grey lores.

A fresh treatment of the grey drongos which are found in Malaysia seems desirable. I propose to regard as one species all the forms intermediate between *leucophaeus* VIEILL., which has black to grey lores and no white on the sides of the head, and *leucogenis* (WALDEN) in which the lores are white and the sides of the head largely white also.

Malaysian races fall into three sections which may be roughly indicated as follows:—

I. No white on the sides of the head:—

D. leucophaeus leucophaeus VIEILL. (Java). Java, Bali.

D. l. celaenus OBERH. Simalur Id., W. Sumatra [1]).

D. l. mouhoti (WALDEN) (Cambodia). Isthmus of Kra, Malay Peninsula.

D. l. hopwoodi BAKER (Dacca, E. Bengal). Isthmus of Kra, Malay Peninsula.

II. White on head confined to the lores:—

D. l. stigmatops SHARPE (Borneo). Borneo.

D. l. phaedra (REICHN.) (West Sumatra). Sumatra [2]).

III. White extending to a variable degree behind the eye:—

D. l. leucogenis (WALDEN) (Japan, errore! China, fide BAKER. Here restricted to YUNNAN). Malay Peninsula to Malacca.

D. l. cerussata (BANGS & PHILLIPS) (Hupeh, China). Malay Peninsula to Trang.

D. l. periopthalmica (SALV.) (Sipora Id.). Sipora and Pagi Ids., Mentawi Group, W. Sumatra [3]).

D. l. siberu CHASEN & KLOSS. Siberut Id., Mentawi Group, W. Sumatra.

With more material now in hand it appears that the characters relied on for distinguishing *batakensis,* viz., "no black frontal band and grey lores not very clearly defined but still paler than the forehead" are of no value. In both Bornean and Sumatran birds the lores vary from white to greyish and the black forehead may be present or absent.

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[1]) Not seen by me. "Like *Dicrurus cineraceus cineraceus* [i.e., *leucophaeus*] from Java, but darker, particularly on the lower surface."

[2]) syn. *D. l. batakensis* ROB. & KLOSS.

[3]) syn. *D. l. diporus* OBERH.

It is highly probable that *phaedra* will have to be reduced to a synonym of *stigmatops,* but I retain it for the present as the Sumatran series before me has the wing a little shorter (121—132 mm) than a Bornean series (wings 125—138 mm) and the tail varies in the same way. There are no other differences.

Some of the birds visiting the northern part of the Malay Peninsula, which have been recorded as *leucogenis,* are so pale that they may fairly be referred to the northern race, *D. l. cerussata* (BANGS & PHILLIPS, Bull. Mus. Comp. Zool., LVIII, 1914, p. 302; *Buchanga leucogenis* BACKWELDER, Carnegie Institute of Washington, Publ. No. 54, 1907, p. 500, plate LXI). At the same time it must be noted that there is complete gradation in colour in my Malayan series between the darker individuals (*leucogenis*) and the pale examples I now call *cerussata.*

Dicrurus borneensis sumatranus WARDL.-RAMS.

1 sex inc., Palembang.

Wing 150 mm.

Chaptia aenea malayensis HAY.

Edolius picinus BONAPARTE.

2 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, Lahat, Palembang.

2 ♀, Medan, N. E. Sumatra.

Wings ♂ 107, 110, 112: ♀ 110, 112, 115 mm.

Dissemurus paradiseus platurus (VIEILL.).

1 sex inc., Djepara, Lampongs. (TANS coll.).

1 sex inc., Lampongs (VORDERMAN coll.).

1 ♂, 2 ♀, Wai Lima, Lampongs.

2 ♂, 1 ♀, Palembang.

1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

1 ♂, Palembajan, Sumatra's Westkust. (OUWENS coll.).

1 ♂, Kajoetanam, Priaman, Sumatra's Westkust. (OUWENS coll.).

1 ♀, 1 sex inc., Medan, N. E. Sumatra.

2 ♀, Aloer Poerba, Acheen.

Wings ♂ 138, 138, 142, 147, 148, 151: ? 137, 146, 147: ♀ 133, 134, 134, 137, 142, 144 mm.

The above series includes material from East, West, North and South Sumatra. Each place shows some individual variation; but I cannot separate the birds from the various localities from each other, nor those of Sumatra as a whole from the birds of the southern half of the Malay Peninsula.

The type locality of *platurus* is Malacca (ROBINSON and KLOSS det. 1920) and these birds from Sumatra seem to be the same as those of the southern third of the Peninsula with Singapore. OBERHOLSER has proposed for East

Sumatran birds *D. p. siakensis* (Siak, E. Sumatra) and for West Sumatran birds *D. p. colpiotes* (Loh Sido Bay, Acheen, N. W. Sumatra) (Journ. Wash. Acad. Sci., XVI, 1926, pp. 519, 520); and for the birds of Singapore Island only, *D. p. messatius* (t.c.s., p. 519).

D. p. hypoballus OBERH. (Journ. Wash. Acad. Sci., XVI, 1926, p. 519. Trang, Peninsular Siam) wil not stand; Dr. OBERHOLSER's argument to show that the name *malayensis* is not available for a form of *Dissemurus paradiseus* is faulty.

[*Edolius*] *Malayensis* BLYTH in JERDON, Birds of India, I, 1862, p. 438, is not "a mistaken identification of *Chaptia malayensis* BLYTH" (i.e. *Chaptia aenea malayensis* HAY in BLYTH, Journ. Asiat. Soc. Bengal, XV, 1846, p. 294: Malacca) but is a citation of *Edolius malayensis* BLYTH, op. cit., XXVIII, 1859, p. 292: Penang and Andamans. JERDON himself regarded this last, quite correctly, as a form allied to *Edolius malabaricus* and cited *C. malayensis* HAY, under *Chaptia aenea*. In 1918 (Ibis, p. 229) I revived *malayensis* as the name for the form of *D. paradiseus* occupying the greater part of the Malay Peninsula and (t.c. p. 518) selected Penang as type locality, at the same time pointing out that JERDON (1862) was not the author of the name, but BLYTH (1859 as above).

If birds from the Mergui Archipelago are distinct they should probably be called *D. p. cristatellus* (BLYTH) [1]) instead of *D. p. mallomicrus* OBERH. (l.c.s.: Hastings Island).

Bhringa remifer remifer (TEMM.).

Bhringa remifer sumatrana HACHISUKA, Bull. B.O.C., XLVII, 1926, p. 57. (Korinchi).

1 ♂, Redelong, Acheen, 1300 metres.

1 ♂, 1 ♀, Geureudong, Acheen, 900 metres.

Wings ♂ 125, 128: ♀ 131 mm. Tail-racket 137 mm.

HACHISUKA has separated Sumatran birds in the belief that they were smaller and had shorter tail-rackets than the typical Javanese race, but this is not the case. Individuals from the two islands are indistinguishable. The Malayan form, *B. r. peracensis* BAKER, which extends to French Indochina, has much longer and narrower rackets.

The species does not occur in Borneo.

ORIOLIDAE.

Oriolus chinensis maculatus (VIEILL.).

2 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀, Palembang.

1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

1 ♂, Pangkalan Koto Baroe, Sumatra's Westkust. (STRASTERS coll.).

1 ♀, 2 sex inc., Medan, N. E. Sumatra.

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[1]) *Edolius cristatellus* (BLYTH, Journ. Asiatic. Soc. Bengal XI, 1842, p. 171: Tenasserim Coast.

1 ♀, Isaq, Acheen, 1000 metres.

1 ♂, Blangkolam, Acheen.

Wings ♂ 140, 141, 141, 142, 145, 148: ? 137, 132, (imm.): ♀ 130, 135, 137, 140 mm.

The young bird has the breast-feathers with brown shaft-stripes.

Oriolus xanthonotus xanthonotus HORSF.

2 ♂, 3 ♀, Wai Lima, Lampongs.

1 ♂, Lahat, Palembang. (VORDERMAN coll).

1 ♀ subad., Isaq, Acheen, 1000 metres.

1 ♀ subad., Aloer Poerba, Acheen.

Wings ♂ 102, 107 (subad.), 107, 112: ♀ 96 (subad.), 98 (subad.), 100 (subad.), 100 mm.

Oriolus cruentus consanguineus (WARDL.-RAMS.).

1 ♂, Sungei Kumbang, Korinchi, 1400 metres. (ROB. & KLOSS coll.).

1 ♀, Isaq, Acheen, 1000 metres.

2 ♂, 1 ♂ imm., Redelong, Acheen, 1300 metres.

1 ♂, Takengon, Acheen, 1200 metres.

2 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 128, 130, 131, 134: ♀ 132, 134, 134 mm.

The young male is black with a few rufescent edges to the feathers of the breast, abdomen and under tail-coverts; the edges of the primaries are white and there is a faint red spot on the edge of the wing.

Of the females two have blackish grey breasts and one of them exhibits an irregular crimson patch in this area. The third female has the breast-feathers edged with pinkish rufous and has a minute red spot near the bend of the wing.

STURNIDAE.

Sturnopaster capensis jalla (HORSF.).

1 ♂, Wai Lima, Lampongs.

Wing 117 mm.

Sturnia sturnina (PALL.).

1 ♀, Talang Betoetoe, Palembang. (OUWENS coll.).

1 ♂, Aloer Poerba, Acheen.

Wings ♂ 105: ♀ 107 mm.

Gracula javana javana (CUV.).

1 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, Palembang.

1 sex inc., Lahat, Palembang.

1 ♂, 1 ♀, Aloer Poerba, Acheen.

Wings ♂ 175, 178, 180: ? 177: ♀ 173, 178 mm.

Aplonis panayensis strigatus (HORSF.).

Lanius insidiator RAFFLES.

1 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♀, 1 sex inc., Palembang.

1 ♀, Aoer, Lahat, Palembang. (STRASTERS coll.).

1 ♂, 2 ♀, Pangkalan Koto Baroe, Sumatra's Westkust. (STRASTERS coll.).

2 ♂, Palembajan, Sumatra's Westkust (OUWENS coll.).

4 ♂, 1 ♀, Medan, N. E. Sumatra.

1 ♂, 1 ♀, Blangkolam, Acheen.

Wings ♂ 92, 93, 93, 95, 96, 97, 98, 99, 101: ? 93: ♀ 88, 88, 94, 94, 95, 96, 98 mm.

Not separable in any way from Javanese birds.

ARTAMIDAE.

Artamus leucoryn amydrus OBERH.

1 ♂, 1 ♀, Palembang.

1 ♂ juv., 1 ♀, Pangkalan Koto Baroe, Sumatra's West Coast. (STRASTERS coll.).

1 ♂, 1 ♀, Isaq, Acheen, 1000 metres.

Wings ♂ 131, 134: ♀ 128, 135, 138 mm.

Young birds are brown above, the feathers of the back and wing-coverts edged with fulvous: the foreneck grey.

PLOCEIDAE.

Munia oryzivora (LINN.).

1 ♂, 1 ♀, Wai Lima, Lampongs.

Wings ♂ 68: ♀ 68 mm.

Munia maja maja. (LINN.).

Loxia leucocephala RAFFLES.

2 ♀, Wai Lima, Lampongs.

1 ♀, 1 ♀ imm., Palembang.

2 ♂, 3 ♀, 3 sex inc., Medan, N. E. Sumatra.

Wings ♂ 52, 52, 55: ? 52, 53, 56: ♀ 53, 54, 54, 55 mm.

The type locality of *Loxia maja* ("Habitat in India oriental'") has been restricted to Malacca. I can perceive no differences between Malayan, Sumatran and Javanese birds. I have not seen *simalurensis* OBERH., of Simalur Id., nor *pallida* WALLACE of Lombok.

Munia atricapilla sinensis BLYTH.

Munia sumatrensis BARTLETT, Mon. Weaverbirds, 1888; Munia, p. 29, plate V, fig. 3.

1 ♂, Pangkalan Koto Baroe, Sumatra's West Coast. (STRASTERS coll.).

Wing 52 mm.

This race is pale, with black confined to head and breast, the colour of the abdomen scarcely, or not at all, deeper than the flanks. It occurs in the southern half of the Malay Peninsula and in parts of Sumatra where it is

probably confined to the lowlands, since in the mountains near Lake Toba occurs a very pale form with a sharply-margined black belly, *M. a. batakana* CHASEN & KLOSS.

Munia atricapilla (?) batakana CHASEN & KLOSS.

Bull. RAFFLES Mus., 2, 1929, p. 23, Brastagi, 1400 metres, N. Sumatra.

1 ♂, Redelong, Acheen, 1300 metres.

Wing 53 mm.

An immature example in the brown stage. Compared with specimens in the same stage of plumage of *M. a. sinensis* BLYTH, the lowland form, it is duller above with a paler head; less buffy below; and has cheeks, ear-coverts and throat greyish white.

It is probably an example of the Sumatran mountain race, adults of which are of a paler chestnut than *sinensis*, but of which I have seen no immature topotypes.

Munia punctulata fretensis subsp. nov.

Closely resembles the Javanese bird, but with the markings of the breast and flanks paler and a little more elongate: throat and foreneck generally darker (twelve adults from the Malay States and eight from Sumatra).

Markings of the undersurface darker and less elongate than in *M. p. subundulata* from the latitude of Mergui (*superstriata* HUME) and from Bangkok, etc., in which the pattern tends to become more stripe-like (many examples examined).

Type. Adult male from Kuala Lumpur, Selangor, Federated Malay States. No. 2184/08.

Wing 53 mm.

Habitat. Malay Peninsula northwards towards the Isthmus of Kra. Sumatra.

Specimens examined:—

1 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀, Palembang.

1 ♂, Pangkalan Koto Baroe, Sumatra's West Coast (STRASTERS coll.).

1 ♂, 1 ♀, 1 sex inc., Medan, N. E. Sumatra.

Wings ♂ 51, 52, 53: ? 52, 53, 53: ♀ 52 mm.

And a good series from the Malay Peninsula. Compared with sixteen specimens from Java.

I had proposed to use *Loxia punctularia* as the name of the Javanese form; but Dr. STRESEMANN has pointed out to me that GMELIN's name is only an amendment, or misprint, for *Loxia punctulata* LINN., and this is undoubtedly the case. Their positions in the sequences in the tenth, twelfth and thirteenth editions are the same, their bases are the same and the descriptions are the same. GMELIN's *punctularia* of Java is therefore synonymous with LINNAEUS' *punctulato* of "Asia", but the former's action has had the effect of restricting the type locality of *punctulata* to Java. It follows that *punctulata punctulata* cannot

be used for the Indian race which must be called *punctulata lineoventer* (*Munia lineoventer* HODGSON, Asiat. Res. XIX, 1836; p. 154. Nepal.).

But by including a reference to BRISSON in the twelfth edition LINNAEUS himself has virtually restricted the type locality.

Munia striata subsquameicollis (BAKER).

Uroloncha acuticauda lepidota OBERHOLSER.

2 ♀, Medan, N. E. Sumatra.

Wing 47, 50 mm.

Munia leucogastra leucogastra (BLYTH).

1 sex inc., Lampongs (VORDERMAN coll.).

Wing 49 mm.

Munia leucogastra leucogastroides HORSF. & MOORE.

3 ♂, 1 ♀, Wai Lima, Lampongs.

Wings ♂ 47, 50, 51: ♀ 49 mm.

M. leucogastra is the bird found in the Malay Peninsula, *M. leucogastroides* that in Java. Both occur in Sumatra ,but I still regard them as subspecifically related and it is probable that *leucogastroides* has spread to, or has been introduced into, Sumatra as it has into Singapore Island.

Erythrura prasina prasina (SPARRM.).

1 ♂, 1 ♀, Palembang.

Wings ♂ 60: ♀ 58 mm.

Ploceus passerinus infortunatus HARTERT.

1 ♂, 1 ♀, Wai Lima, Lampongs.

5 ♂, Medan, N. E. Sumatra.

Wings ♂ 68, 70, 70, 70, 71, 71: ♀ 67 mm.

FRINGILLIDAE.

Passer montanus malaccensis DUBOIS.

1 ♀, Tabat Patah, Pajokomboe, Sumatra's Westkust. (GROENEVELD coll.).

2 ♀, 1 sex inc., Medan, N. E. Sumatra.

Wings ♂ 63, 65, 70: ? 67 mm.

MOTACILLIDAE.

Motacilla cinerea caspica (S. G. GM.).

Motacilla melanope AUCT.

1 ♂, 1 ♀, Wai Lima, Lampongs. December.

2 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres. September.

Wings ♂ 77: ♀ 77, 78, 78 mm.

Motacilla flava simillima HARTERT.

1 ♂, 1 sex inc., Palembang. January and February.

Wings ♂ 81: ? 78 mm.

Dendronanthus indicus (GM.).

1 sex inc., Lampongs (VORDERMAN coll.).

1 ♂, Lho Seumawe, Acheen.

2 ♂, Aloer Poerba, Acheen.

Wing 75, 75, 75, 79 mm.

Anthus richardi malayensis EYTON.

1 sex inc., Lampongs (VORDERMAN coll.).

1 ♂, Poentian, near Palembang Town. (STRASTERS coll.).

2 ♀, Medan, N. E. Sumatra.

1 ♂, Geureudang, Acheen, 900 metres.

Wings ♂ 75, 79: ? 80: ♀ 78, 79 mm.

NECTARINIIDAE.

Aethopyga mystacalis temmincki (S. MÜLL.).

1 ♂, Sungei Kumbang, Korinchi, 1400 metres (ROBINSON and KLOSS coll.).

1 ♂, Takengon, Acheen, 1000 metres.

Wings ♂, 58, 60 mm.

Aethopyga siparaja siparaja (RAFFLES).

1 ♂, Lampongs. (VORDERMAN coll.).

4 ♂, 1 ♀, Wai Lima, Lampongs.

1 ♂, Pangkalan Koto Baroe, Sumatra's Westkust. (STRASTERS coll.).

1 ♂, Fort de Kock, Sumatra's Westkust, 1000 metres.

1 ♂, Medan, N. E. Sumatra.

Wings ♂ 49, 50, 51, 51, 52, 52, 53: ♀ 45 mm.

Leptocoma brasiliana brasiliana (GM.).

1 ♂, Blangkolam, Acheen.

Wing 48 mm.

Leptocoma jugularis pectoralis (HORSF.).

2 ♂, 1 ♀, Wai Lima, Lampongs.

2 ♂, Medan, N. E. Sumatra.

1 ♂, Takengon, Acheen, 1200 metres.

1 ♂ ad., 1 ♂ imm., 1 ♀, Isaq, Acheen, 1000 metres.

1 ♀, Blangkolam, Acheen.

Wings ♂ 50, 51, 52, 53, 53, 54, 54: ♀ 49, 50 mm.

The male from Isaq has the breast bordered with brown, showing an approach to the race *L. j. flammaxillaris* of Peninsular Siam northwards.

Anthreptes macularia hypogrammica (S. MÜLL.).

Anthreptes hypogrammica intensior HARTERT, Bull. B.O.C., XXXVIII, 1917, p. 27. Sarawak.

2 ♂, Wai Lima, Lampongs.

2 ♂ imm., Aloer Poerba, Acheen.

Wings 64, 65, 66, 67 mm.

MÜLLER described *Nectarinia hypogrammica* as from Sumatra and Borneo and I now have sufficient material to state that birds from both places are alike. (Sumatra is to be regarded as *terra typica*). They differ from the Malayan bird, *macularia* (as HARTERT stated when proposing *intensior*) in being of a deeper yellow on the under-side, especially on the throat and breast where the edges of the feathers are often whitish in the typical form. Occasionally, however, the Malayan bird is as richly coloured as the Bornean-Sumatran and *vice versa*.

The younger birds are altogether duller, have little or no blue above and are much paler yellow, more olivaceous below.

Anthreptes simplex (S. MÜLL.).

1 ♀ imm., Wai Lima, Lampongs.
1 ♂, Blangkolam, Acheen.
Wing ♂ 65 mm.

Anthreptes malaccensis malaccensis (SCOP.).

2 ♂, 2 ♀, Wai Lima, Lampongs.
1 ♂, Poentian, near Palembang Town. (STRASTERS coll.).
2 ♂, 1 ♀, Pangkalan Koto Baroe, Sumatra's Westkust. (STRASTERS coll.).
2 ♂, 3 ♀, Medan, N. E. Sumatra.
2 ♂, 1 ♀, 1 juv., Blangkolam, Acheen.
Wings ♂ 64, 65, 66, 66, 66, 67, 67: ♀ 59, 60, 61. 61, 61, 62, 63 mm.

Anthreptes rhodolaema SHELLEY.

1 ♂, Wai Lima, Lampongs.
1 ♂, Blangkolam, Acheen.
Wings ♂ 67, 69 mm.

Arachnothera longirostra longirostra (LATH.).

Arachnothera longirostra melanchima OBERHOLSER, Smiths. Misc. Collns. LX, No. 7, 1912, p. 7. Siak, E. Sumatra.
2 ♀, Wai Lima, Lampongs.
1 ♀, Talang Betoetoe, Palembang.
2 ♂, Poentian, near Palembang Town. (STRASTERS coll.).
1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).
1 ♂, Isaq, Acheen, 1000 metres.
1 ♂, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.
1 ♂, Blangkolam, Acheen.
Wings ♂ 67, 69, 69, 69, 70, 70: ♀ 59, 60, 60, 61 mm.

I cannot separate the Sumatran bird from the Malayan (Isthmus of Kra to Singapore) of which OBERHOLSER makes two races:— *antelia* of Trang, Peninsular Siam; and *heliocrita* confined to Singapore Island (Journ. Wash. Acad. Sci., XIII, 1923, pp. 227, 228).

If the Malayan bird is different from the typical form of Assam (BAKER, 1926, says it is not) it will apparently have to be called *A. l. pusilla* BLYTH

(Cat. Birds Mus. Asiat. Soc., 1849, p. 328) a new name for *A. affinis* BLYTH (Journ. Asiat. Soc. Bengal, XV, 1846, p. 43. Eastern Coast of the Bay of Bengal from Arracan to Malacca).

Arachnothera affinis (HORSF.) subsp.

3 ♂, 1 ♀ ad., 3 ♀ imm. and juv., Wai Lima, Lampongs.

1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

Wings ♂ 80, 81, 81, 83: ♀ 72 ad.: 3 juv. 70 mm.

This bird varies in any one place in length of bill, colour of upper parts and stripes on the breast. The last are absent in young birds which are often strongly washed with green on the lower surface.

The male from Palembang and one from Wai Lima have large greenish-yellow patches on the lower back and there are traces of the same on the other males. This feature is not present in specimens I have examined from Central Sumatra (*A. concolor* SCHLEGEL, Pl. 1, AVES in VETH's Midden-Sumatra, IV, 1887) and Northeast Sumatra (? *A. affinis heliophilus* OBERH., Acheen) all of which, with Bornean birds, are inseparable from the Malayan *A. affinis modesta* (EYTON). Nor does it occur in the typical and very distinct Javanese bird, nor in *A. everetti* (SHARPE) of Borneo, also apparently a race of *A. affinis* in spite of its curious distribution in the island. However, for the present I regard it as an abberration rather than a racial character and so do not propose a name for southern Sumatran birds.

Arachnothera chrysogenys chrysogenys TEMM.

2 ♀, Wai Lima, Lampongs.

Wings 79, 80 mm.

I have before me 37 examples from Java (*A. c. chrysogenys* TEMM.); Sumatra (*A. c. copha* OBERH., N. W. Sumatra); the Mentawi Islands (*A. c. isopega* OBERH., Pagi Island); Borneo; the Malay Peninsula (*A. c. intensiflava* BAKER [1]); South Tenasserim (*A. c. astilpna* OBERH.). I have not seen birds from Nias Islands, *A. c. pleoxantha* OBERH., based on a single example of unknown sex with a wing of 96 mm (fide RILEY): if the figures are not a misprint the birds of Nias Island attain unusual size. In my considerable series the maximum wing lengths are 89 mm (Penang Island) and 90 mm (North Borneo).

The measurements of the series are:—

Java		♀ 78 (subad.)
Sumatra	♂ 83—86	♀ 79—81
Mentawi Ids.	♂ 86 [2])	
Nias	sex inc. 96 (?): fide RILEY.	
Borneo	♂ 84—90	♀ 77—80
S. Tenasserim	♂ 85	♀ 78
Malay Peninsula	♂ 84—89	♀ 78—85

[1]) The type locality is Kossoom, not in Tenasserim as stated, but in the province of Takuatung in Peninsular Siam, lat. 8°20′ N. The subspecies proposed was stated to range from Mergui in Tenasserim to Singapore.

[2]) Specimen in moult, but the longest primary is still present in one wing.

Except for the single Nias bird there is no regardable difference in size. Individual colour variation in any one place (largely dependent on the date of the last moult) is somewhat marked but I can see no local differences: freshly moulted birds are yellower below and a rather brighter green above. The size of the bill varies noticeably everywhere and cannot be used as a distinguishing character.

Arachnothera robusta robusta MÜLL. & SCHL.

1 ♂, Lampongs. (VORDERMAN coll.).

Wing 88 mm.

Arachnothera flavigaster (EYTON).

1 ♂, Lampongs. (VORDERMAN coll.).

1 ♂, Palembang.

1 ♀, Aloer Poerba, Acheen.

Wings ♂ 108, 109: ♀ 94 mm.

DICAEIDAE.

Dicaeum cruentatum sumatranum CAB.

1 ♂, Lampongs. (VORDERMAN coll.).

2 ♂, Poentian, near Palembang Town. (STRASTERS coll.).

1 ♂, Benkoelen. (VORDERMAN coll.).

1 ♂, Fort de Kock, Sumatra's Westkust, 1000 metres. (GROENEVELD coll.).

1 ♀, Medan, N. E. Sumatra.

1 ♂, Lho Seumawe, Acheen.

1 ♂ juv., 2 ♀, Blangkolam, Acheen.

Wings ♂ 44, 45, 45, 45, 46, 47: ♀ 42, 43, 43 mm.

It is towards this black-throated Sumatran race that many Bornean males (*nigrimentum* SALV.) are tending.

Dicaeum trigonostigma trigonostigma (SCOP.).

6 ♂, 4 ♀, Wai Lima, Lampongs.

1 ♂, Pagar Alam, Palembang, 500—750 metres.

1 ♂ juv., Aoer, Lahat, Palembang.

1 ♂, 1 ♀, Medan, N. E. Sumatra.

2 ♂, 1 ♀, Blangkolam, Acheen.

Wings ♂ 47, 47, 47, 47, 47, 48, 48, 50, 47 juv., 49 imm.: ♀ 43, 46, 47, 47, 50 mm.

Young males are like adult females.

Dicaeum chrysorrhoeum chrysorrhoeum TEMM.

1 ♂, Talang betoetoe, Palembang.

1 ♂, 1 ♀, Blangkolam, Acheen.

Wings ♂ 57, 58: ♀ 55 mm.

Prionochilus percussus ignicapillus (EYTON).

4 ♂, Wai Lima, Lampongs.

1 ♂, Talang Betoetoe, Palembang.

1 ♂, Blangkolam, Acheen.

Wings 54, 54, 55, 55, 57, 57 mm.

Slightly immature males have a few olive feathers on the upper parts and the wings edged with the same colour.

Prionochilus maculatus maculatus (TEMM.).

1 ♂, Wai Lima, Lampongs.

Wing 53 mm.

ZOSTEROPIDAE.

Zosterops aureiventer sumatrana subsp. nov.

1 ♂, 2 ♀, Wai Lima, Lampongs.

1 ♂, 1 ♀, Isaq, Acheen, 1000 metres.

Wings ♂ 50, 50: ♀ 49, 51, 52 mm.

Javanese and Sumatran birds average yellower above than Malayan and Bornean. Of the material before me from the first two localities the Sumatran series has the forehead, loral line and foreneck less yellow, and therefore less bright, than in *Z. a. buxtoni* NICHOLSON, of Java and the difference seems to be of subspecific value.

Type. Adult male obtained at Siolak Dras, Korinchi Valley, Sumatra, 900 metres, by H. C. ROBINSON and C. BODEN KLOSS on 19th May 1914. Wing 49 mm.

Seven Sumatran compared with four Javanese specimens.

The continental race, *Z. a. aureiventer* HUME (syn. *tahanensis* O.-GRANT; ? *mesoxantha* SALV.) besides being duller in colour has a markedly larger bill. The Bornean form, *Z. a. media* ROB. and KLOSS (syn. *Z. a. parvus* HACHISUKA) is also a dull bird but has a slightly brighter rump than *Z. a. aureiventer* and has the small bill of *buxtoni* and *sumatrana*. The Javanese race is the most brightly coloured of the four subspecies.

Zosterops chlorates korinchi subsp. nov.

Zosterops montana ROBINSON and KLOSS (not BONAPARTE), Journ. Fed. Malay States Mus., VIII, part 2, 1918, p. 248 (Korinchi Peak); id., op. cit. XI, 1924, p. 338 (Mt. Talamau).

Zosterops chlorates chlorates STRESEMANN (not HARTLAUB), Mitt. Zool. Mus. Berlin, 17, Band 2, 1931, p. 215 (Korinchi and Talamau Mts.).

1 ♂ Korinchi Peak, 3000 metres (ROBINSON and KLOSS coll.).

Wing 58 mm.

Size about as in *Z. c. neglecta* SEEBOHM, of East Java; rather smaller than *Z. c. sindorensis* SIEBERS [1]) of Mid and West Java: bill larger than in either. Underparts brighter: foreneck and breast deeper yellow and abdomen much more washed with primrose yellow; isabelline area much more extensive and brightly coloured than in the Javanese forms (*Z. c. sindorensis* does not differ in colour from *neglecta*).

[1]) Treubia, XI, 1929, p. 151. (Mt. Tjiremai).

Not entirely yellow below as *Z. difficilis* ROB. & KLOSS, from Mt. Dempu, South Sumatra [1]).

Wings of *neglecta* (19 ex.) 52 (once) 54—56, 57 (once) 58 (once)
„ *sindorensis* (31 ex.) 58—61.5 (fide SIEBERS)
„ *korinchi* (29 ex.) 55—59.

Type: adult male collected on Korinchi Peak, 10,000 ft., Sumatra, on 9 May 1914 by H. C. ROBINSON and C. BODEN KLOSS. Wing 57 mm.

Specimens examined: a large series from between height of 7,300 ft. and 10,500 feet.

On consideration I am now unable to refer this bird to *Z. montana* BP. (probably from Mt. Singgalang or Mt. Merapi in the Padang Highlands) as the description of that is "Like *Z. flava* of Java but a little larger." Neither can I apply to it HARTLAUB's name *Z. chlorates*, for a bird from Morotai Island, in the northern Molucca group. This provenance has been rejected by several authors, but I see no need to query it. There is no reason to doubt the presence of a *Zosterops*, and of *chlorates* in particular, on Morotai: for that island is in an area possessing numerous forms only subspecifically distinct from it (fide STRESEMANN, Mitt. Zool. Mus. Berl. 17, 1931, pp. 215—216).

It is possible that the yellow-bellied *Zosterops difficilis* ROBINSON and KLOSS, Journ. Fed. Malay States Mus., VIII, part 2, 1918, p. 250 (*Zosterops chlorates* SHARPE, Cat. Birds B. M. IX, 1884, p. 191, ROBINSON, Bull. Liverpool Mus. II, 1899, p. 47, pl. 1, fig. 1) is the *Zosterops montana* of BONAPARTE of 1850, "Similis *Z. flavae* ex Java, sed paullo major" but I am not yet prepared to place *difficilis* as a synonym of BONAPARTE's unidentified name since on account of its brown-tinged flanks it seems to be merely a still more richly coloured ally of the Javanese birds than is the present one.

While no form of *Zosterops flava* has been obtained in Sumatra since BONAPARTE described *montana* in 1850, there is intrinsically no reason why one should not occur. On the other hand, the presence of an "*Oreosterops*" is strongly to be doubted and BONAPARTE's *Oreosterops montana* of 1854 is probably a synonym of *Zosterops javanica* (HORSF.), or *Z. frontalis* REICHENB. both of Java.

Zosterops atricapilla SALV.

1 ♂, 2 ♀, Pajatoengkalan, Pangmoh, Acheen, 2000 metres.

Wings ♂ 58: ♀ 55 mm.

Like FINSCH I find Kinabalu birds (*Z. clara* SHARPE) of which a large series is before me, identical with those of Sumatra.

CHALCOPARIIDAE.

Chalcoparia singalensis sumatrana KLOSS.

1 ♀ juv., Wai Lima, Lampongs.

2 ♂, 1 ♂, Aoer, Lahat, Palembang. (STRASTERS coll.).

Wings ♂ 53, 56: ♀ 53, 53 mm.

[1]) Journ. Fed. Malay States Mus., VIII, part 2, 1918, p. 250; id., op. cit. XI, 1924, p. 338.

UEBER EINIGE VOGELSAMMLUNGEN DES BUITENZORGER MUSEUMS VON DEN KLEINEN SUNDA-INSELN.

Von

BERNHARD RENSCH.

(Zool. Museum, Berlin).

Herr Dr. DAMMERMAN hatte die grosse Freundlichkeit, einige kleinere Vogelsammlungen von den Inseln Bali und Flores, sowie die wertvolle von ihm selbst zusammengebrachte Ausbeute von Sumba dem Berliner Museum zur Bearbeitung zu überlassen. Alle diese Kollektionen enthielten eine Reihe interessanter Neunachweise für die einzelnen Inseln, sodass eine vollständige Aufzählung wohl am Platze ist [1]).

I. Ueber die von Dr. Dammerman im Jahre 1925 auf Sumba gesammelten Vögel.

Die Insel Sumba ist zum grössten Teile mit Alang-Flächen, dürrem Buschwald oder Monsunwald bedeckt. Ueppige Regenwälder, wie sie sich auf Flores finden, fehlen fast vollständig. Da zudem auch keine höheren Gebirge vorhanden sind — die höchste Erhebung beträgt 1225 m — so ist anzunehmen, dass die Ornis erheblich formenärmer ist, als die der nördlichen Nachbarinseln. Bis 1925 waren durch die Sammlungen Dr. RIEDELS, Dr. H. TEN KATES, W. DOHERTYS und A. EVERETTS bereits 103 Vogelarten von Sumba bekannt, sodass eine wesentliche Erhöhung dieser Zahl nicht mehr zu erwarten war. Trotzdem gelang es Herrn Dr. DAMMERMAN bei seiner 2½-monatigen Sammeltätigkeit unter Assistenz von Herrn Taxidermist P. FRANCK noch weitere 14 Formen neu nachzuweisen und darunter einige sehr interessante Endemismen, die den Eindruck verstärken, dass diese Insel schon relativ lange isoliert ist. Die Mehrzahl dieser Vögel wurde bereits von H. C. SIEBERS beschrieben. Von vielen Formen wurden auch grössere Serien gesammelt, die es ermöglichten, einige neue, ziemlich scharf differenzierte geographische Rassen aufzustellen. Im ganzen enthielt die Ausbeute 3 neue Arten und 8 neue geographische Rassen, von denen 1 Art und 5 Rassen im folgenden beschrieben werden.

Da bisher nur in wenigen Fällen Masse von Sumba-Vögeln publiziert wurden — HARTERT gab im allgemeinen nur bei Neubeschreibungen Masse an, und dann auch nur die Flügelmasse — so füge ich für alle vorliegenden Individuen die Länge der Flügel (gestreckt), des Schwanzes (von der Wurzel

[1]) Für die Synonymik der Formen verweise ich auf meine Arbeit: Die Vogelwelt von Lombok, Sumbawa und Flores. Mitteil.Zool.Mus.Berlin, im Druck.

der mittleren Steuerfedern zur äussersten Federspitze mit dem Zirkel gemessen) und des Culmens (vom Beginn der Stirnbefiederung bis zur Spitze mit dem Zirkel gemessen) hinzu.

1. **Irrediparra gallinacea gallinacea** (TEMMINCK).
Kambera, 23.—29.III., 3 ♂, 1 ♀.
♂ Fl. 120;121; 124 mm; Schw. 35; 34; 36 mm; Culmen 14; 15,5; 14 mm. — ♀ Fl. 142 mm; Schw. 35 mm; Culmen 13 mm.
Die Testes der ♂ waren stark geschwollen, das ♀ besass ein fast legereifes Ei.

2. **Excalfactoria chinensis lineatula** RENSCH.
Excalfactoria chinensis lineatula RENSCH, Mitteil.Zool.Mus.Berlin, im Druck.
Kananggar, 15.—21.V.,2 ♀ juv.
Neunachweis für Sumba.

3. **Megapodius reinwardt reinwardt** DUMONT.
Mao Marroe, 6.V., 1 juv.

4. **Turnix maculosa everetti** HARTERT.
Kambera, 25.III., 1 ♀, 1 ♂ juv.
♀ Fl. 77 mm; Schw. 24 mm; Culmen 11 mm.
Das ♀ besass ein fast legereifes Ei.

5. **Streptopelia chinensis tigrina** (TEMMINCK).
Kambera, 20.III., 1 ♂.
Fl. 150 mm; Schw. 140 mm; Culmen 17 mm.
Die Testes waren stark geschwollen.

6. **Geopelia striata maugea** (TEMMINCK).
Kambera, 20.—27.III., 1 ♀, 1 ?. — Laora, 14.IV., 1 ♀.
♀ Fl. 99; 100 mm; Schw. 108; 111 mm; Culmen 13; 13 mm.
Die Ovarien beider ♀ waren sehr stark geschwollen.

7. **Chalcophaps indica indica** (LINNAEUS).
Kambera, 20.III., 1 ♀. — Mao Marroe, 10.V., 1 ♂ juv.
♀ Fl. 142 mm; Schw. 87 mm; Culmen 15 mm.
Das Exemplar besass ein fast legereifes Ei.

8. **Ducula problematica** sp. nov.
Laora, 13.IV., 1 ♂.

D i a g n o s e. Von *D. aenea* unterschieden durch braunschwarze, statt kastanienbraune Unterschwanzdecken und durch am Balge hell rötlichbraunen Schnabel (bei *aenea*: grauschwarz mit hell gelblicher Spitze). Die vorderen Stirnfedern (unmittelbar hinter den Nasenlöchern) sind auch braunlicher, weniger weiss als bei *aenea* und das graue Nackengefieder ist nicht so scharf von dem bronzefarbenen Rückengefieder abgesetzt, wie dies im allgemeinen bei *D. aenea* der Fall ist (doch ist diese letztere Differenz nicht immer deutlich). —
Fl. 249 mm; Schw. 157 mm; Culmen 25 mm.

Typus: das beschriebene Exemplar im Zoologischen Museum zu Berlin.

Das Vorhandensein einer zweiten, der *D. aenea* sehr ähnlichen Fruchttaube auf Sumba ist sehr überraschend, und ich war mir auch längere Zeit im Zweifel, ob das vorliegende Stück nicht als Aberration anzusehen sei. Da jedoch mehrere abweichende Merkmale vorhanden sind, muss es sich doch wohl um eine eigene Art handeln, von der weiteres Material natürlich sehr erwünscht wäre.

Die Testes waren etwas geschwollen.

9. **Treron curvirostra teyssmanni** (Schlegel).

Kambera, 24.III., 1 ♀ juv. — Laora, 13.—17.IV., 2 ♂, 1 ♀, 1 ♂ juv. — Mao Marroe, 10.V., 1 ♂.

♂ Fl. 163; —; — mm; Schw. 96; 104; — mm; Culmen 16; —; 15,5 mm; ♀ Fl. 162 mm; Schw. 94 mm; Culmen 14 mm.

2 ♂ mausern die Schwingen. Die jungen Stücke haben viel geringere Masse. Die äussern Schwanzfedern sind z. B. nur 14 mm breit (bei erwachsenen Stücken etwa 21 mm). — Testes zweier ♂ waren mehr oder minder geschwollen. Das ♀ besass ein fast legereifes Ei.

10. **Ptilinopus melanocephalus melanocephalus** (Forster).

Karoni, 7.IV., 1 juv. — Mao Marroe, 5.—9.V., 2 ♂, 1 ♀.

♂ Fl. 118; 123 mm; Schw. 65; 75 mm; Culmen 12; 14 mm.

Das kleinere ♂ mit unentwickelten Testes ist mit dem Lichte gesehen oberseits kupferbraun, das grössere mit etwas geschwollenen Testes ist mit dem Lichte gesehen olivgrün. Vielleicht sind allgemein die reiner grünen Tiere als die älteren anzusehen.

11. **Tringa hypoleucos** Linnaeus.

Kambera, 21.—22.III., 2 ♂, 2 ♀.

♂ Fl. 111; 111 mm; Schw. 57; 59 mm; Culmen 27; 23,5 mm. — ♀ Fl. 111; 112 mm; Schw. 53; 57 mm; Culmen 23; 25 mm.

12. **Tringa glareola** Linnaeus.

Karoni, 9.IV., 1 ?.

13. **Ardeola speciosa** (Horsfield).

Laora, 10.IV., 2 ♂.

Fl. 201; 216 mm; Schw. 65; 82 mm; Culmen 50; 59 mm.

Die Testes beider Stücke waren stark geschwollen.

14. **Butorides striatus javanicus** (Horsfield).

Kambera, 25.III. m 1 ♀.

Fl. 183 mm; Schw. 68 mm; Culmen —.

Das Exemplar besass ein fast legereifes Ei.

15. **Ixobrychus sinensis** (Gmelin).

Kambera, 23.III., 1 Exemplar ohne Geschlechtsangabe.

16. **Bubulcus ibis coromandus** (BODDAERT).
Kambera, 31.III., 1 ♀.
Fl. 245 mm; Schw. 85 mm; Culmen —.

17. **Notophoyx novaehollandiae novaehollandiae** (LATHAM).
Karoni, 9.IV., 1 ♂, 1 ♀. — Laora, 11.IV., 1 ♀.
♂ Fl. 317 mm; Schw. 133 mm; Culmen 80 mm. — ♀ Fl. 302; 315 mm; Schw. 117; 132 mm; Culmen 77; 79 mm.
Die Gonaden aller 3 Exemplare waren mehr oder minder geschwollen.

18. **Anas superciliosa percna** RILEY.
Karoni, 19.IV., 2 ♀. — Laora, 9.—16.IV., 1 ♂, 2 ♀ im Dunenkleide. — Kananggar, 17.V., 1 ♂, 1 ♀.
♂ Fl. 258; — mm; Schw. 83; — mm; Culmen 47; 53 mm. — ♀ Fl. 241; 242; 249 mm; Schw. 83; 79; 82 mm; Culmen 45; 45; 46 mm.
Die Dunenjungen von Laora (Mitte April) beginnen bereits zu mausern. — Die Gonaden aller ad. Exemplare waren (noch ?) mehr oder minder geschwollen.

19. **Dendrocygna arcuta** (HORSFIELD).
Kambera, 29.III., 1 ♂, 3 Dunenjunge (1 ♂, 2 ♀).
Fl. 209 mm; Schw. 50 mm; Culmen 47 mm.
Die Testes des ad. ♂ waren etwas geschwollen. — Die Dunenjungen von Kambera waren offenbar erst wenige Tage alt. Sie unterscheiden sich von Dunenjungen von *A. superciliosa* dadurch dass der dunkelbraune Augenstreif und der dunkelbraune Wangenfleck mit dem dunkelbraunen Oberkopfgefieder verbunden sind. Der Oberschnabel ist am Balge braunschwarz mit hellbraunen Nagel.

20. **Accipiter fasciatus tjendanae** STRESEMANN.
Kambera, 26.III., 1 ♀. — Pajeti, 28.V., 1 ♀ juv.
♀ Fl. 255 mm; Schw. 189 mm; Culmen 18 mm. ♀ juv. Fl. 253 mm; Schw. 198 mm; Culmen 18,5 mm.
Das ad. ♀ besass ein fast legereifes Ei.

21. **Haliastur indus intermedius** GURNEY.
Kambera, 21.—27.III., 1 ♂, 1 ♀. — Waikelo, 25.IV., 1 ♀ juv. — Kananggar 11.V., 1 ♂.
♂ Fl. 377; 379 mm; Schw. 197; 195 mm; Culmen 24; 23 mm. — ♀ Fl. 380 mm; Schw. 192 mm; Culmen 25 mm.
Die Gonaden waren etwas geschwollen.

22. **Haliaëtus leucogaster** (GMELIN).
Kambera, 26.III., 1 ♀ (Fl. 565 mm).
Neunachweis für Sumba! — Ovar und Ovidukt waren schwach geschwollen.

23. Elanus caeruleus hypoleucus Gould.

West-Soemba, 20.IV., 1 ♀.

Fl. 288 mm; Schw. 130 mm; Culmen 19 mm.

Das Ovar befand sich im Ruhezustande. — Neunachweis der Art für Sumba.

24. Milvus migrans affinis (Gould).

W. Soemba, 19.IV., 1 ♂ (Fl. 407 mm).

Ein junges Stück, bei dem die Spitzen der Kopf- und Nackenfedern noch weisslich sind (Testes klein).

25. Circus assimilis assimilis Jard. & Selby.

Kambera, 22.III., 1 ♀ (Fl. 438 mm; Schw. 283 mm; Culmen (von der Wachshaut an) 22.5 mm.

Bei der kleineren Celebischen Rasse ist das Braun der Unterseite und der Unterflügeldecken lebhafter rostrot. Wahrscheinlich handelt es sich bei dem Sumbavogel um einen australischen Wintergast. — Ovar und Ovidukt waren etwas geschwollen.

26. Baza subcristata timorlaoënsis Meyer.

Karoni, 7.IV., 1 ♀.

Fl. 310 mm; Schw. 197 mm; Culmen 22 mm.

Das Ovar befand sich im Ruhezustande.

27. Falco moluccensis renschi Siebers.

Pajeti, 28.III., 1 ♂, 1 ♀. — Kambera, 25.III., 1 ♂. — Laora, 10.IV., 1 ♂. — West-Soemba, 8.—21.IV., 1 ♂, 1 ♀. — Waikelo, 24.IV., 1 ♀. — Kananggar, 20.V., 1 ♂.

Diese kürzlich von H. C. Siebers beschriebene Rasse (Treubia, 7, Suppl., p. 234—41, 1930) ist durch erheblich blassere Unterseite deutlich von der Rasse *occidentalis* geschieden, die sich auch noch auf Lombok, Sumbawa und Flores findet. — Die Gonaden waren zum Teil schwach geschwollen.

28. Ninox fusca rudolfi Meyer.

Kambera, 29.III., 1 ♂.

Fl. 227 mm; Schw. 138 mm; Culmen 17 mm.

Die Testes befanden sich im Ruhezustande.

29. Tyto alba sumbensis (Hartert).

Karoni, 8.—13.IV., 3 ♀.

Fl. 282; 282; 287 mm; Schw. 119; 115; 119 mm; Culmen 23; 22; 23 mm.

Die Gonaden befanden sich im Ruhezustande.

30. Tanygnathus megalorhynchus sumbensis Meyer.

West-Soemba, 31.V. — 30.VI., 2 ♀, 1 ?.

♀ Fl. 244; 254 mm; Schw. —; 174 mm; Culmen 43; 45 mm. — ? Fl. 244 mm; Schw. 166 mm; Culmen 45 mm.

Die Ovarien befanden sich im Ruhezustande.

31. **Geoffroyus geoffroyi tjindanae** MEYER.

Kambera, 19.—25.III., 4 ♂, 3 ♀, 2 ♀ juv. — Mao Marroe, 8.—10.V., 1 ♂, 1 ♀, 1 ♂ juv. (2. Jugendkleid). — Kananggar, 20.V., 1 ♀ juv.

♂ Fl. 162—168 mm, durchschn. 165 mm; Schw. 81—87 mm, durchschn. 85 mm; Culmen 21—22 m, durchschn. 21,5 mm. — ♀ Fl. 167; 171; 171; — mm; Schw. 88; 92; 92; — mm; Culmen 22; 20; 23; 22 mm.

Die Masse bestätigen aufs Neue, dass die Rasse *tjindanae* durchschnittlich etwas grösser ist als *floresiana* SALVAD. Das 2. Jugendkleid des ♂ gleicht dem Alterskleide des ♀, doch ist der Oberschnabel bereits ziemlich stark rot. — Die Gonaden aller erlegten Exemplare befanden sich im Ruhezustande.

32. **Eclectus roratus cornelia** BONAPARTE.

Laora, 12.IV., 1 ♂. — Waikelo, 24.IV., 1 ♂. — Mao Marroe, 6.V., 1 ♀.

♂ Fl. 260; 267 mm; Schw. 147; 152 mm; Culmen 40; 40 mm. — ♀ Fl. 248 mm; Schw. 144 mm; Culmen 36 mm.

Diese bisher als Art betrachtete Form ist in den *roratus*-Rassenkreis einzubeziehen. — Die vorliegenden Stücke mausern zum Teil das Grossgefieder. — Die Testes des ♂ vom 12.IV. waren (noch) etwas geschwollen.

33. **Trichoglossus ornatus fortis** HARTERT.

Mao Marroe, 11.V., 1 ♂, 1 ♀. — Kananggar, 18.V., 1 ♀.

♂ Fl. 152 mm; Schw. 122 mm; Culmen 22 mm. — ♀ Fl. 146; 149 mm; Schw. 118; 117 mm; Culmen 20,5; 20 mm.

Die Unterflügeldecken des ♂ sind mehr rot als gelb, die Brust ist orange und gelb, die Körperseiten sind rot und gelb gemischt. Die Unterflügeldecken der ♀ zeigen nur wenig Rot.

34. **Cacatua sulphurea citrinocristata** (FRASER).

Laora, 12.IV., 1 ♂, 1 ♀. — Mao Marroe, 11.V., 1 ?.

♂ Fl. 252 mm; Schw. 131 mm; Culmen 36 mm.

♂ und ♀ mausern das Grossgefieder. — Das Ovar war geschwollen.

35. **Eurystomus orientalis connectens** STRESEMANN.

Kambera, 19.—24.III., 2 ♂, 2 ♀. — Laora, 13.—14.IV., 2 ♀.

Alle Exemplare mausern das Grossgefieder. — Die Gonaden befanden sich im Ruhezustande.

36. **Rhyticeros everetti** (ROTHSCHILD).

Mao Marroe, 4.V., 1 ♀.

Fl. 315 mm; Schw. 254 mm; Culmen 61 + 62 mm.

Eine der Steuerfedern besitzt einen etwa 2 mm breiten, weissen Rand am distalen Ende — eine Aberration, die auf die nahe Verwandtschaft zu den weisschwänzigen Formen hindeutet.

37. **Alcedo atthis floresiana** SHARPE.

Kananggar, 16.—20.V., 3 ♂, 1 ♀.

♂ Fl. 72; 73; 75 mm; Schw. 29; 31; 34 mm; Culmen 38; 38; 39 mm. — ♀ Fl. 73 mm; Schw. 31 mm; Culmen 39 mm.

Der braune Fleck zwischen Auge und Oberschnabel ist bei den Sumbavögeln etwas blasser als bei 3 verglichenen Exemplaren von Sumbawa und Flores. Sollte sich dieser Unterschied an weiterem Materiale bestätigen, so müsste eine schwache Sumba-Rasse abgetrennt werden. — Die Gonaden der erlegten Stücke waren kaum geschwollen.

38. **Halcyon chloris chloris** (Boddaert).

Pajeti, 15.III., 1 ♂. — Kambera, 18.—21.III., 1 ♂, 1 ♀. — Laora, 22.IV., 1 ♂, 1♀. — Kananggar, 18.V., 1 ♂.

♂ Fl. 104; 104; 106; 107 mm; Schw. 64; 66; 67; 64 mm; Culmen —; 45; 42; 43 mm. — ♀ Fl. 102; 102; 110 mm; Schw. 65; 65; 67 mm; Culmen 42; 42; 44 mm.

Die Gonaden befanden sich im Ruhezustande.

39. **Merops ornatus** Latham.

Kambera, 22.—24.III., 1 ♀, 1 ♂ juv., 1 ♀ juv. — Laora, 13.IV., 1 ♂, 1 ♀.

♂ Fl. 105 mm; Schw. 78 + 39 mm; Culmen 32 mm. — ♀ Fl. 102; 103 mm; Schw. 75 + 6; 73 + 9 mm; Culmen 30; 31 mm.

Die Gonaden befanden sich im Ruhezustande.

40. **Merops superciliosus javanicus** Horsfield.

Kambera, 15.—29.III., 1 ♂, 1 ♂ juv.

Fl. 129 mm; Schw. 87 + 58 mm; Culmen 38 mm.

41. **Collocalia esculenta sumbawae** Stresemann.

West-Soemba, 17.—20.IV., 2 ♀, 3 ?, 2 ♂ juv. — Mao Marroe, 5.—8.V., 1 ♂, 4 ?, 7 juv. (Nestjunge). — Kananggar, 21.V., 1 ♂, 1 ♀, 1 ?.

♂ Fl. 91; 91 mm; Schw. 38; 39 mm; Culmen 3,5; 3,5 mm. — ♀ Fl. 93; 93; 98 mm; Schw. 38; —; 42 mm; Culmen 3; 4; 3 mm. — 7 Exemplare ohne Geschlechtsangabe: Fl. 91—95 mm, durchschn. 93 mm; Schw. 39—43 mm, durchschn. 40 mm; Culmen 3—4 mm, durchschn. 3,5 mm.

Die Gonaden waren zum Teil etwas geschwollen.

42. **Collocalia franica micans** Stresemann.

Mao Marroe, 8.V., 3 ♀, 2 ?.

Schwingen und Steuerfedern des Grossgefieders sind noch nicht ganz ausgewachsen, nur bei einem ♀ zeigen die Schwingen keine Reste der Federscheiden mehr: Länge 115 mm. — Ovarien befanden sich im Ruhezustande.

43. **Cuculus optatus** Gould.

Kambera, 21.III, 1 ♂.

Fl. 195 mm; Schw. 140 mm; Culmen 19 mm.

Neunachweis dieses ostasiatischen Zugvogels für Sumba.

44. **Eudynamis scolopacea everetti** Hartert.

West-Soemba (Karoni, Laora), 7.—19.IV., 4 ♂, 3 ♀, 1 ♂ juv., 1 ♀ juv.

♂ Fl. 204; 214; 217 mm; Schw. 205; 206; 212 mm; Culmen —; 30; 27; 27 mm. — ♀ Fl. 212; 213; — mm; Schw. 199; 202; — mm; Culmen 29; 30; — mm.

Das offenbar bisher noch nicht beschriebene weibliche Jugendkleid dieser Rasse unterscheidet sich vom weiblichen Alterskleide (♀ mit legereifen Eiern verglichen) durch einfarbig rostbraune Unterseite, ungefleckten schwarzen Oberkopf und ungefleckte schwarze Bartstreifen, sowie durch den Mangel des grünen Schillers auf der Oberseite. — Das vorliegende junge ♂ mausert aus dem Jugend- ins Alterskleid: das Bauchgefieder ist rotbraun, mit einigen schwarzen Federn durchsetzt, das übrige Gefieder ist bereits schwarz. — Die Testes der ♂ waren kaum geschwollen, alle 3 ♀ besassen dagegen fast legereife Eier.

45. Centropus bengalensis sarasinorum STRESEMANN.

Kambera, 18.—19.III., 1 ♂, 1 ♀. — Laora, 21.IV., 2 ♂ pull.

♂ Fl. 152 mm; Schw. 190 mm; Culmen 23 mm. — ♀ Fl. 168 mm; Schw. 210 mm; Culmen 27 mm.

Die Gonaden waren sehr stark geschwollen.

46. Hirundo tahitica frontalis QUOY & GAIMARD.

Kambera, 22.III., 1 ♀. — Karoni, 7.—16.IV., 1 ♂, 1 ?, 1 ♀ juv.

♂ Fl. 107 mm; Schw. 44 mm; Culmen 8 mm. — ♀ Fl. 103 mm; Schw. 44 mm; Culmen 9 mm.

Das Ovar des ♀ war etwas geschwollen.

47. Hirundo daurica rothschildiana RENSCH.

Hirundo daurica rothschildiana RENSCH, Mitteil.Zool.Mus.Berlin, im Druck.

Laora, 19.—20.IV., 3 ♀.

Fl. 120; 121; 121 mm; Schw. 68; 62; 64 mm; Culmen 8; 8; 8 mm.

Alle 3 Stücke mausern Schwingen und Steuerfedern. — Die Gonaden befanden sich im Ruhezustande.

Die Masse bestätigen die Notwendigkeit der Abtrennung der Vögel von den Kleinen Sunda-Inseln als besondere Rasse *rothschildiana*.

48. Culicicapa ceylonensis connectens nov.

Culicicapa ceylonensis HARTERT, Novit.Zool., 3, p. 584, 1896.

Mao Marroe, 5.V., 1 ♂.

Diagnose. Die graue Kinnpartie ist etwas ausgedehnter als bei *sejuncta* HART. von Flores. Die hellgelben Federn, die sich bei *sejuncta* zwischen Kinn und Wangen bis zur Schnabelwurzel hinziehen, sind nicht vorhanden. Ausserdem sind die Sumba-Vögel deutlich grösser: das vorliegende ♂ hat eine Flügellänge von 60 mm, 4 ♂ des Tring-Museums, deren Masse mir Herr A. GOODSON freundlichst mitteilte, besitzen sogar Längen von 61; 61; 63; 63 mm. 3 *sejuncta*-Stücke des Tring-Museums von Flores messen dagegen 58; 58; 59 mm (nach GOODSON in litt.), 1 weiteres Exemplar des Buitenzorger Museums 58 mm. Die Sumba-Rasse vermittelt also in Färbung und Massen zwischen *sejuncta* und *ceylonensis,* steht aber ersterer Form näher.

Typus: das vorliegende ♂ im Zoologischen Museum zu Berlin.

Die Testes dieses Stückes befanden sich im Ruhezustande.

49. Terpsiphone paradisi sumbaënsis Meyer.

Kambera, 19.—28.III., 1 ♀, 1 ♂ juv., 1 ♀ juv. — Karoni, 6.—7.IV., 1 ♀, 1 ♀ juv. — Laora, 8.—16.IV., 5 ♂, 2 ♀, 2 ♂ juv. — Mao Marroe, 6.V., 1 ♀.

♂ Fl. 98—102 mm, durchschn. 99,5 mm; Schw. 351—72 mm, durchschn. 360 mm; Culmen 19—20 mm, durchschn. 19 mm. — ♀ Fl. 92—95 mm, durchschn. 93 mm; Schw. 133—177 mm; durchschn. 153 mm; Culmen 17—20 mm, durchschn. 18 mm.

Die jungen ♂ und ♀ sind gleich gefärbt. Sie besitzen einen kürzeren Schwanz (96—112 mm) als alte ♀.

Die Masse zeigen, dass die Rasse *sumbaënsis* deutlich grösser ist als die Rasse *floris,* deren ♂ nur eine Flügellänge von 90—97 mm haben.

Die beiden verlängerten mittleren Schwanzfedern sind meist ungleich lang, ein Beispiel dafür, dass Excessiv-Organe allgemein eine erhöhte Variabilität zeigen. — Ein ad. ♂ von Kambera zeigt eine interessante Aberration: die Steuerfedern sind ungleichmässig mit Phaeomelanin-Streifen und -Flecken gezeichnet. Es ist dies ein Hinweis auf die nahe Verwandtschaft zu den Formen, bei denen im männlichen Geschlechte eine braune Mutante vorkommen kann (vergl. auch weiter unten das bei *T. p. floris* Gesagte). — Die Testes aller ♂ waren etwas geschwollen.

50. Rhipidura rufifrons sumbensis Hartert.

Mao Marroe, 5.—6.V., 3 ♂, 3 ♀. — Kananggar, 15.—21.V., 4 ♂, 1 ♀, 1 ♂ juv.

♂ Fl. 70—74 mm, durchschn. 72 mm; Schw. 88—94 mm, durchschn. 91 mm; Culmen 9—10 mm, durchschn. 10 mm. — ♀ Fl. 68—72 mm, durchschn. 69,5 mm; Schw. 87—93 mm, durchschn. 89 mm; Culmen 9—10,5 mm, durchschn. 9,5 mm.

Da die vorliegenden Stücke durchschnittlich grösser sind als solche von Timor und Wetar (*semicollaris* S. Mueller: Fl. 69—71 mm), so ist also die Rasse *sumbensis* Hart. (Novit.Zool.,3,p.585,1896) anzuerkennen, was Hellmayr bezweifelt hatte (Vögel von Timor, p. 32, Stuttgart 1914).

Das offenbar gerade flügge gewordene ♂ juv. ist durch den Mangel des schwarzen Kropfbandes und durch etwas dunkleren Oberkopf ausgezeichnet. — Die Testes aller ad. ♂ waren stark geschwollen.

51. Myiagra ruficollis ruficollis (Vieillot).

Kambera, 19.—26.III., 2 ♂, 2 ♂ juv., 2 ♀ juv. — Mao Marroe, 5.—9.V., 2 ♂. — Kananggar, 15.—21.V., 1 ♂, 1 ♀, 1 ♂ juv.

♂ Fl. 68—73 mm, durchschn. 71 mm; Schw. 68—70 mm, durchschn. 69 mm; Culmen 11—12 mm, durchschn. 11 mm. — ♀ Fl. 70 mm; Schw. 68 mm; Culmen 11 mm.

Das ad. ♀ ist an der Kehle ebenso dunkel rotbraun wie die meisten ♂. Dagegen sind alle jungen ♂ hell rotbraun. — Nur bei einem ♂ (20.III.) waren die Testes stark geschwollen.

52. Alseonax (latirostris) segregata Siebers.

Kambera, 22.—28.III., 3 ♀, 1 ♂ juv., 2 ♀ juv. — Laora, 21.IV., 1 ♀, 1 ?.

♀ Fl. 63; 66; 66; 67 mm; Schw. 47; 49; 49; 47 mm; Culmen 12; 12; 12; 12 mm.

Ueber diese merkwürdig isolierte Rasse, die man wegen ihrer ganz anderen Flügelformel und wegen des relativ langen Schnabels vielleicht besser als eigene Art bezeichnen würde, vergleiche man H. C. SIEBERS (l.c.p. 400—402). — Die Ovarien befanden sich im Ruhezustande.

53. Erythromyias harterti SIEBERS.

Kananggar, 21.V., 1 ♀.

Die Art hat offenbar mit *E. dumetoria* von Lombok und Sumbawa nichts zu tun, da der Schnabel länger, flacher und scharffirstiger ist. Doch kann ohne Kenntnis des ♂ nichts Positives über die Verwandtschaftsbeziehungen gesagt werden (vergl. SIEBERS, l.c.p. 402—03.).

54. Rhinomyias stresemanni (SIEBERS).

Microeca stresemanni SIEBERS, Treubia, 10, p. 399, 1928.

Mao Marroe, 6.—7.V., 1 ♂, 1 ♀.

Wie *Rh. oscillans* von Flores so ist auch diese Art nicht zu *Microeca,* sondern zu *Rhinomyias* zu stellen. Es handelt sich um eine selbständige Art, die nicht mit der viel kleineren, graueren und kurzschnäbligeren *Rh. oscillans* von Flores zu einem Rassenkreise vereinigt werden kann. — Die Gonaden befanden sich im Ruhezustande.

55. Saxicola caprata francki nov.

Pratincola caprata HARTERT, Novit.Zool., 3, p. 580, 1896.

Kambera, 19.III.—3.IV., 3 ♂, 1 ♀. — Laora, 12.—17.IV., 1 ♂, 2 ♀. — Mao Marroe, 6.—7.V., 1 ♂, 1 ♀. — Kananggar, 15.—19.V., 3 ♂, 2 ♀.

D i a g n o s e. Von der von Java bis Timor und Babar verbreiteten Rasse *pyrrhonota* (VIELL.) (= *fruticola* HORSF.) sind die Sumbavögel im weiblichen Geschlechte unterschieden durch weisse oder blass cremefarbene Bürzelfedern und Unterschwanzdecken so wie durch gleichmässigere und hellere Tönung des braunen Gefieders. In letzterem Merkmale differieren sie auch von der ebenfalls weissbürzeligen Rasse *aethiops* (SCL.). Die Masse sind die gleichen wie bei *pyrrhonota.*

♂ Fl. 70—75 mm, durchschn. 73 mm; 51—55 mm, durchschn. 53 mm; Culmen 10—12 mm, durchschn. 11 mm. — ♀ Fl. 68—72 mm, durchschn. 70 mm; Schw. 50—56 mm, durchschn. 53 mm; Culmen 10,5—12 mm, durchschn. 11 mm.

T y p u s im Zoologischen Museum, Berlin: 1 ♀ von Laora, 12.IV.

Die Gonaden aller Exemplare befanden sich im Ruhezustande. Einige Stücke mauserten Schwingen und Steuerfedern.

56. Lalage nigra sueurii (VIEILLOT).

Pajeti, 16.III., 1 ♀. — Kambera, 19.—22.III., 1 ♂, 1 ♀. — Laora, 21.IV., 1 ♀ juv. — Kananggar, 12.—22.V., 4 ♂, 4 ♀, 4 ♂ juv.

♂ Fl. 90—93 mm, durchschn. 92 mm; Schw. 68—72 mm, durchschn. 69 mm;

Culmen 12—14 mm, durchschn. 13 mm. — ♀ Fl. 89—94 mm, durchschn. 91,5 mm; Schw. 69—76 mm, durchschn. 71 mm; Culmen 12—14,5 mm, durchschn. 13,5 mm.

Die Gonaden der meisten Exemplare waren wenig geschwollen, 1 ♀ vom 22.III. besass ein fast legereifes Ei. Die Brutzeit liegt also wohl im Februar und März.

57. **Graucalus sumbensis** (Meyer).

Kambera, 20.—21.III., 1 ♂, 1 ♀.

♂ Fl. 180 mm; Schw. 155 mm; Culmen 23 mm. — ♀ Fl. 176 mm; Schw. 144 mm; Culmen 25 mm.

Die Gonaden waren ein wenig geschwollen.

58. **Acrocephalus stentoreus sumbae** Hartert.

Kambera, 30.III., 1 ♂.

Fl. 70 mm; Schw. 60 mm; Culmen —

Hartert gab in der Urbeschreibung (Treubia, 6, p. 21, 1924) als Flügelmasse nur 66—67 mm an, Salomonsen (Journ. f. Ornithol., Erg. Bd. II, p. 277, 1929) 66—69 mm. Das vorliegende Stück ist also sehr gross. Da das Gefieder sehr stark abgerieben ist, müsste man sogar genauer mit einer Flügellänge von 71 mm rechnen. — Die Testes waren sehr stark geschwollen.

59. **Cisticola juncidis fuscicapilla** Wallace.

Karoni, 15.IV., 1 ♂, 2 ♀, 1 ?. — Laora, 18.IV., 1 ?. — Mao Marroe, 7.V., 1 ♂.

♂ Fl. 48; 49 mm; Schw. 41; 35 mm; Culmen 9,5; 10 mm. — ♀ Fl. 45; 49 mm; Schw. —; —; Culmen 9,5; 10 mm.

Ein ♂ und ein ♀ vom 15.IV. tragen noch das Brutkleid und hatten etwas stärker geschwollen Gonaden, das andere ♀ vom 15.IV. ist im Ruhekleide und hatte wenig geschwollene Ovarien, das ♂ vom 7.V. ist im Ruhekleide und hatte sehr kleine Testes.

60. **Megalurus timoriensis inquirendus** Siebers.

Kananggar, 17.V., 1 ♂.

Ueber diese Form vergleiche man Siebers, l.c. p. 403—404.

61. **Phylloscopus borealis examinandus** Stresemann.

Kambera, 18.—29.III., 7 ♂, 2 ?.

♂ Fl. 65—72 mm, durchschn. 70 mm; Schw. 50—52 mm, durchschn. 51 mm.

62. **Lanius cristatus superciliosus** Latham.

Kambera, 22.23.III., 1 ♂, 1 ♀. — Laora, 18.—21.IV., 2 ?.

Die beiden Stücke von Kambera mausern das Grossgefieder, die beiden Exemplare von Laora sind frisch vermausert (Fl. 91; 91 mm).

63. **Pachycephala pectoralis fulviventris** Hartert.

Kambera, 19.—26.III., 5 ♂, 2 ♀, 1 ♂ juv. — Karoni, 6.—8.IV., 1 ♂, 1 juv. — Laora, 12.—18.IV., 2 ♂, 1 ♀, 1 ♂ juv. — Waikelo, 24.IV., 1 ♂. — Mao Marroe, 4.—12.V., 4 ♂, 6 ♀. — Kananggar, 12.—21.V., 5 ♂, 1 juv.

♂ Fl. 82—87 mm, durchschn. 84,5 mm; Schw. 60—64 mm, durchschn. 62 mm; Culmen 14—17 mm, durchschn. 16 mm. — ♀ Fl. 80—87 mm, durchschn. 82 mm; Schw. 60—65 mm, durchschn. 62,5 mm; Culmen 14,5—16 mm, durchschn. 15 mm.

Die jungen ♂ unterscheiden sich von den ♀ durch den grünen statt grauen Hinterkopf. — Die Gonaden der meisten Exemplare waren stark geschwollen.

64. **Corvus coronoides timorensis** BONAPARTE.

Kambera, 23.—27.III., 2 ♂, 1 ♀.

♂ Fl. 316; 322 mm; Schw. 186; 185 mm; Culmen 60; 64 mm. — ♀ Fl. 286 mm; Schw. 169 mm; Culmen 49 mm.

Bei dem abnorm kleinen ♀ sind die Wurzel des Oberschnabels und die proximalen zwei Drittel des Unterschnabels nicht pigmentiert. — Die Gonaden aller 3 Exemplare befanden sich im Ruhezustande.

65. **Dicrurus hottentottus sumbae** nov.

Chibia bimaënsis HARTERT, Novit.Zool., 3, p. 583, 1896 (Sumba).

Karoni, 6.IV., 1 ♀. — Laora, 10.—16.IV., 2 ♀.

D i a g n o s e. Die Rasse verbindet den langschwänzigen *D. densus* (BP.) von Timor mit dem Rassenkreise *D. hottentottus*. Sie ist in allen Massen kleiner als *densus* von Timor und grösser als *bimaënsis* WALL. von Sumbawa und Flores. *D. hottentottus vicinus* RENSCH von Lombok besitzt etwa gleiche Flügelmasse, hat aber einen viel kürzeren Schwanz, der zudem auch einen mehr bläulichen Schiller besitzt. Die Flügelmasse der Sumba-Vögel betragen: 140; 143; 144 mm. Die recht erheblichen Differenzen der Schwanzlängen seien zur Unterscheidung der einzelnen Rassen noch einmal nebeneinander gestellt: *vicinus* (Lombok) 122—32 mm, *bimaënsis* (Sumbawa, Flores) 107—128 mm, *sumbae* (Sumba) 142—49 mm, *densus* (Timor) 152—67 mm.

T y p u s im Zoologischen Museum Berlin: 1 ♀ von Laora (Fl. 144 mm).

Alle 3 Exemplare begannen Schwingen und Steuerfedern zu vermausern. — Die Ovarien befanden sich im Ruhezustande.

66. **Artamus leucorhynchus celebensis** BRUEGGEMANN.

Kambera, 20.III., 1 ♂, 2 ♀. — Kananggar, 21.V., 1 ♂, 1 ♀.

♂ Fl. 139 mm; Schw. 63 mm; Culmen 18 mm. — ♀ Fl. 134; 135 mm; Schw. 63; 62 mm; Culmen 20; 20 mm.

Die Exemplare mausern zum Teil das Grossgefieder. — Die Gonaden befanden sich im Ruhezustande.

67. **Oriolus chinensis broderipi** BONAPARTE.

Kambera, 19.—27.III., 3 ♂, 2 ♀. — Laora, 11.—21.IV., 3 ♀, 1 ♂ juv. — Mao Marroe, 8.—12.V., 2 ♂, 1 ♀.

♂ Fl. 149—166 mm, durchschn. 156 mm; Schw. 100—114 mm, durchschn. 106 mm; Culmen 32—34 mm, durchschn. 33 mm. — ♀ Fl. 149—160 mm, durchschn. 154 mm; Schw. 103—114 mm, durchschn. 106 mm; Culmen 33—35 mm, durchschn. 34 mm.

Die Gonaden fast aller Exemplare waren mehr oder weniger geschwollen.

68. Aplonis minor (BONAPARTE).

Laora, 13.—21.IV., 2 ♂, 1 ♂ juv., 1 ♀ juv.

Die beiden ad. ♂ mausern das Grossgefieder. Das ♂ juv. mausert aus dem Jugend- in das Alterskleid. — Die Testes befanden sich im Ruhezustande.

69. Munia quinticolor (VIEILLOT).

Pajeti, 15.III., 1 ♂. — Kambera, 28.III., 1 ♀. — Laora, 8.—21.IV., 3 ♂, 2 ♀ juv. — Kananggar, 18.—20.V., 1 ♂, 4 ♀, 1 ♂ juv.

♂ Fl. 54—58 mm, durchschn. 56 mm; Schw. 35—40 mm, durchschn. 38 mm; Culmen 11—13 mm, durchschn. 12 mm. — ♀ Fl. 53—55 mm, durchschn. 54 mm; Schw. 34—38 mm, durchschn. 36 mm; Culmen 11—12 mm, durchschn. 11,5 mm.

Der Bürzel ist bei 7 Exemplaren dunkel kastanienbraun, bei 3 gelbbraun. Das ♂ juv. ist unter- und oberseits lebhafter rotbraun als die beiden ♀ juv. — Die Gonaden der meisten ad. Exemplare waren ziemlich stark geschwollen.

70. Munia punctulata blasii STRESEMANN.

Kambera, 28.III., 1 ♂, 1 ♀.

♂ Fl. 48 mm; Schw. 32 mm; Culmen 9,5 mm. — ♀ Fl. 50 mm; Schw. 34 mm; Culmen 10 mm.

Die Gonaden waren stark geschwollen.

71. Munia molucca propinqua (SHARPE).

Karoni, 8.IV., 1 ♂. — Kananggar, 15.—18.V., 1 ♂, 1 ♀, 1 ♀ juv.

♂ Fl. 51; 52 mm; Schw. 37; 38 mm; Culmen 10; 10 mm. — ♀ Fl. 50 mm; Schw. 37; Culmen 10,5 mm.

Das ♀ juv. ist schon ziemlich vollständig vermausert (18.V.). — Die Gonaden der 3 ad. Stücke waren wenig geschwollen.

72. Taeniopygia guttata guttata (VIEILLOT).

Pajeti, 16.III., 1 ♀. — Kambera, 19.—28.III., 3 ♂, 3 ♀.

♂ Fl. 53; 53; 54 mm; Schw. 33; 35; 34 mm; Culmen 9; 9,5; 9 mm. — ♀ Fl. 52—54 mm, durchschn. 53,5 mm; Schw. 32—34 mm, durchschn. 33,5 mm; Culmen 9—9,5 mm, durchschn. 9 mm.

Die Gonaden waren mehr oder weniger stark geschwollen.

73. Amandava flavidiventris (WALLACE).

Karoni, 9.—15.IV., 3 ♂. — Laora, 15.IV., 1 ♂. — Kananggar, 17.22.V., 2 ♂, 1 ♀.

♂ Fl. 45—46 mm, durchschn. 45,5 mm; Schw. 33—35,5 mm, durchschn. 34,5 mm; Culmen 9 mm. — ♀ Fl. 45 mm; Schw. 33 mm; Culmen 8,5 mm.

Diese Art, die ich auf Lombok und Flores stets nur zwischen 800 und 2400 m antraf, lebt auf Sumba interessanterweise auch im Tieflande. — Die Testes der vorliegenden Stücke waren mehr oder minder stark geschwollen.

74. Mirafra javanica parva SWINHOE.

Kambera, 19.—27.III., 4 ♂, 1 ?.

♂ Fl. 70; 71; 72; 73 mm; Schw. 44; 45; 46; 48 mm; Culmen 11; 11,5; 12; 11,5 mm. — Die Testes aller 4 ♂ waren sehr stark geschwollen.

75. **Anthus novaezealandiae albidus** STRESEMANN.

Pajeti, 15.III., 1 ♂, 1 ♀, 1 ?. — Kambera, 19.—20.III., 1 ♂, 1 ♀. — Mao Marroe, 9.V., 1 ♀. — Kananggar, 15.—22.V., 2 ♀.

♂ Fl. 81; 84 mm; Schw. 63; 61 mm; Culmen 13; 13 mm. — ♀ Fl. 76—78 mm, durchschn. 77 mm; Schw. 56—61 mm, durchschn. 58 mm; Culmen 13—14 mm, durchschn. 13,5 mm.

Die Gonaden befanden sich im Ruhezustande.

76. **Motacilla flava simillima** HARTERT.

Karoni, 15.IV., 1 ♀. — Laora, 15.—20.IV., 1 ♂, 1 ♀, 1 ♀ juv., 2 ?.

♂ Fl. 82 mm; Schw. 68 mm; Culmen 12,5 mm. — ♀ Fl. 79 mm; Schw. 70 mm; Culmen 11,5 mm.

Bei einem ♀ sind der Oberkopf olivbraun, die Kopfseiten dunkelbraun und die Kropfgegend bräunlichgelb. Ich halte dies für das weibliche Jugendkleid.

77. **Parus major cinereus** VIEILLOT.

Kambera, 27.—28.III., 2 ♂, 1 ?, 1 ♂ juv. — West-Soemba, 7.IV., 1 ?. — Laora, 8.IV., 1 ♀ juv. — Kananggar, 18.V., 1 ♂.

♂ Fl. 62; 65; 65 mm; Schw. 55; 55; — mm; Culmen 10; 9; — mm.

Die beiden juvenilen Stücke begannen in das Altersgefieder zu mausern. Bei einem ♂ vom 27.III. waren die Gonaden ziemlich stark geschwollen.

78. **Stigmatops indistincta limbata** (S. MUELLER).

Kambera, 25.III., 1 ♂. — Laora, 4.—17.IV., 2 ♂, 1 ♀. — Mao Marroe, 5.V., 2 ♂. — Kananggar, 15.—20.V., 1 ♂, 2 ♀.

♂ Fl. 71—75 mm, durchschn. 72 mm; Schw. 57—59 mm, durchschn. 57 mm; Culmen 16—17,5 mm, durchschn. 16,5 mm. — ♀ Fl. 64; 65; 65 mm; Schw. 53; 50; 52 mm; Culmen 16; 15,5; 15,5 mm.

Die Masse, besonders die des Schwanzes sind etwas geringer als bei Exemplaren von Bali bis Flores (bei 6 ♂ mass ich hier: Fl. 72—75 mm, durchschn. 73 mm; Schw. 59—64 mm, durchschn. 61 mm; Culmen 16,5—17,5 mm, durchschn. 17 mm). Auch ist die Färbung oberseits durchschnittlich etwas blasser und gelblicher, doch sind alle diese Differenzen zu gering und zu wenig konstant, um eine besondere geographische Rasse abzutrennen. — Die Gonaden aller Exemplare waren ziemlich stark geschwollen.

79. **Myzomela erythrocephala dammermani** SIEBERS.

Mao Marroe, 4.—10.V., 3 ♂, 2 ♀, 1 ♂ juv. — Kananggar, 18.V., 1 ♂.

♂ Fl. 55—57 mm, durchschn. 56 mm; Schw. 35—39 mm, durchschn. 37 mm; Culmen 14—15 mm, durchschn. 14 mm. — ♀ Fl. 51; 52 mm; Schw. —; 33 mm; Culmen 13; 13 mm.

Nach einem gestopften Exemplare des Berliner Museums zu urteilen, ist das ♀ der Nominatrasse an der Brust ein wenig heller als das von *dammermani*. — Die Gonaden aller Exemplare waren mehr oder minder geschwollen, auch die Testes des ♂ juv.

80. Philemon buceroides sumbanus nov.

Pajeti, 16..III., 1 ♂. — Kambera 21.—31.III., 4 ♂. Mao Marroe, 7.V., 1 ♀ (Nestjunges).

D i a g n o s e. Die Sumba-Vögel sind langflügeliger und langschwänziger als die Nominatrasse von Timor und die Rassen *neglectus* (BUETTIK.) von Lombok bis Flores und *plesseni* RENSCH von Lomblen, Pantar und Alor. Sie sind underseits kurzschnäbliger als Exemplare der Rasse *pallidiceps* von Wetar, die etwa gleiche Flügel- und Schwanzmasse besitzen.

♂ Fl. 155—160 mm, durchschn. 157 mm; Schw. 136—141 mm, durchschn. 139 mm; Culmen 45—46 mm, durchschn. 45 mm. (Dagegen Flügelmasse bei *buceroides* ♂ 149—155 mm [1]), bei *neglectus* ♂ 144—148 mm, bei *plesseni* ♂ 148—156 mm; bei *pallidiceps* ♂ Fl. 154—158 mm, aber hier die Schnabelmasse ♂ 48—51 mm). Von der Rasse *pallidiceps* sind die Sumba-Stücke auch durch dunklere Färbung, vor allem des Oberkopfes, unterschieden.

T y p u s im Zoologischen Museum zu Berlin: 1 ♂ von Kambera (Fl. 160 mm).

Die Testes waren bei 2 ♂ stark, bei 1 ♂ schwach, bei 2 ♂ garnicht geschwollen.

81. Anthreptes malacensis rubrigena nov.

Anthreptes malaccensis celebensis HARTERT, Novit.Zool., 3, p. 581, 1896.

Kambera, 20.—18.III., 1 ♂, 1 ♀. — Laora, 10.—17.IV., 4 ♂, 2 ♀. — Waikelo, 25.IV., 1 ♀. — Mao Marroe, 7.V., 1 ♂, 1 ♀.

D i a g n o s e. Das ♂ unterscheidet sich von der benachbarten Rasse *convergens* RENSCH (Sumbawa-Alor) vor allem durch das Fehlen der lebhaft rotbraunen Schulterfärbung. Nur die Ränder der Flügeldecken zeigen noch schmale, matt rotbraune Säume. Die Wangen sind dagegen viel stärker braun als bei der Rasse *convergens*, meist völlig rotbraun (*convergens*: olivgrün). Die gleichen Merkmale trennen die Sumbavögel von der Rasse *celebensis* SHELL. von Celebes, *chlorigaster* SHPE. von den Philippinen und *malacensis* SCOP. von Malakka bis Bali, nur mit dem Unterschiede dass in diesen letzteren Fällen die Färbungsdifferenz nicht so gross ist. Die Rasse *celebensis* hat ausserdem eine mehr olivenfarbige, *malacensis* eine reiner gelbe Unterseite. Die ♀ sind an Kopf und Vorderrücken grauer als die Rassen *convergens, celebensis, chlorigaster* und *malacensis*.

♂ Fl. 64—69 mm, durchschn. 67 mm; Schw. 41—45 mm, durchschn. 43,5 mm; Culmen 18,5—19 mm, durchschn. 18,5 mm. — ♀ Fl. 61—63 mm, durchschn. 63 mm; Schw. 37,5—40 mm, durchschn. 39 mm; Culmen 17—18,5 mm, durschschn. 18 mm.

T y p u s im Zoologischen Museum zu Berlin: 1 ♂ von Laora (Fl. 67 mm).

Auf die merkwürdige Tatsache, dass die Sumba-Vögel der Celebes-Rasse etwas ähnlicher sehen als der zwischen beiden eingeschobenen Rasse *convergens* (Sumbawa-Alor) werde ich späterhin bei einer Darstellung der tiergeographischen Beziehungen der Kleinen Sunda-Inseln noch einmal zurürckkommen. — Die Gonaden aller ad. Exemplare waren mehr oder minder stark geschwollen.

[1]) Nach C. E. HELLMAYR, Avifauna von Timor, p. 47, Stuttgart 1914.

82. Cinnyris solaris buettikoferi HARTERT.

Pajeti, 16.III., 1 ♂. — Kambera, 19.—27.III., 3 ♂, 1 ♀. — Karoni, 7.IV., 1 ♂. — Laora, 12.—18.IV., 4 ♂, 2 ♀. — Waikelo, 24.IV., 1 ♂ juv. — Mao Marroe, 5.—10.V., 4 ♂, 2 ♀, 1 ♀ juv.

♂ Fl. 51—54 mm, durchschn. 53 mm; Schw. 32—35 mm, durchschn. 33 mm; Culmen 18—20 mm, durchschn. 19 mm. — ♀ Fl. 47—50 mm, durchschn. 49 mm; Schw. 29—30 mm, durchschn. 30 mm; Culmen 17,5—19 mm, durchschn. 18,5 mm.

Die ♀ der bisher als eigene Art betrachteten *C. buettikoferi* entsprechen denen des Rassenkreises *C. solaris,* nicht denen des Rassenkreises *C. jugularis.* Die Jungen unterscheiden sich von den ad. ♀ durch schmutzig grünlichgrauen, statt grauen Rücken. — Die Gonaden aller Exemplare waren mehr oder minder stark geschwollen, besonders bei den im März erlegten.

83. Dicaeum sanguinolentum wilhelminae BUETTIKOFER.

Karoni, 7.IV., 3 ♂. — Laora, 13.—17.IV., 3 ♂, 1 ♀. — Mao Marroe, 4.—10.V., 3 ♂, 2 ♀.

♂ Fl. 50—54 mm, durchschn. 52 mm; Schw. 25—27 mm, durchschn. 26,5 mm; Culmen 5 mm. — ♀ Fl. 50; 50,5; — mm; Schw. 25; 25; — mm; Culmen 9; 9; 9 mm.

Ein mauserndes ♀ (5.V.) hat stärker grünliches Rückengefieder und grünlichere Körperseiten. Es handelt sich dabei wohl um das Jugendkleid. Die Gonaden aller übrigen Exemplare waren mehr oder minder stark geschwollen.

84. Piprisoma obsoletum (S. MUELLER).

Laora, 17.—19.IV., 1 ♂, 3 ♀, 1 ?.

♂ Fl. 55 mm; Schw. 16 mm; Culmen 8 mm. — ♀ Fl. 54; 55; 56 mm; Schw. 27,5; 26; 27,5 mm; Culmen 7; 7,5; 7 mm.

Die Ovarien der ♀ waren ein wenig geschwollen.

85. Zosterops wallacei FINSCH.

Kambera, 22.—28.III., 1 ♂, 1 ?. — West-Soemba, 7.IV., 1 ♀. — Laora, 17.—19.IV., 2 ♂, 1 ♀. — Waikelo, 24.IV., 1 ?. — Mao Marroe, 4.—11.V., 4 ♂, 1 ♀, 1 ?.

♂ Fl. 54—57 mm, durchschn. 56 mm; Schw. 40—43 mm, durchschn. 41 mm; Culmen 10,5—11,5 mm, durchschn. 11 mm. — ♀ Fl. 54; 55; Schw. 39; 41; 41 mm; Culmen 10; 10,5; 11 mm.

Die Gonaden der meisten Exemplare waren mehr oder weniger stark geschwollen.

86. Zosterops citrinella intercalata STRESEMANN.

Zosterops citrinella intercalata STRESEMANN, Mitteil.Zool.Mus.Berlin. 17, p. 217, 1931,

Kambera, 21.—28.III., 1 ♂, 1 ♀. — Pajeti, 29.III., 1 ♀. — Mao Marroe, 6.—9.V., 4 ♂, 1 ♀, 1 ?. — Kananggar, 19.—22.V., 2 ♂, 1 ♀.

♂ Fl. 54—58 mm, durchschn. 57 mm; Schw. 38—43 mm, durchschn. 40 mm; Culmen 9,5—11,5 mm, durchschn. 10,5 mm. — ♀ Fl. 55—58 mm, durchschn. 56,5 mm; Schw. 38—41 mm, durchschn. 40 mm; Culmen 10—11,5 mm, durchschn. 11 mm.

Es handelt sich um eine graubäuchige *Zosterops*form, die auch in den Küstenebenen vorkommt. Ob die auf diese ökologische Tatsache begründete Trennung der Rassenkreise *chlorates* und *citrinella*, in der ich vorläufig Stresemann folge, berechtigt ist, wird noch zu erweisen sein. Da auch *Amandava flavidiventris*, die im Heimatgebiet von *Z. chlorates chlorates*-Rassen ebenfalls ausschliesslich Gebirgsbewohner ist, in Sumba im Tieflande lebt, so ist eine gewisse Skepsis hinsichtlich der Rassenkreis-Abgrenzung wohl nicht unberechtigt.

Die Gonaden der meisten Exemplare waren mehr oder minder stark geschwollen.

Die sorgfältigen Angaben über den Zustand der Gonaden lassen schliesslich auch einen Schluss auf die Bruttätigkeit zu. Von den gesammelten Standvögeln zeigten 31 Formen mehr oder minder stark geschwollene Gonaden und bei 21 Formen waren die Gonaden im Ruhezustande. Für die Mehrzahl der Vögel liegt also die Sammelzeit vom 11. März bis zum 22. Mai in einer Fortpflanzungsperiode. Eine entsprechend gelegene Hauptbrutzeit am Ende der Regenzeit konnte ich auch bereits für die Vögel der Nachbarinseln Lombok, Sumbawa und Flores konstatieren (Mitteil. Zool. Mus. Berlin, im Druck) und Aehnliches berichtet auch H. J. V. Sody von Java [1]. —

Da es an einer zusammenfassenden Darstellung der Vögelwelt Sumbas fehlt, möchte ich zum Schlusse eine Liste der von dieser Insel bisher bekannt gewordenen Formen zusammenstellen. Zugvögel sind dabei mit einem * bezeichnet.

1. *Gallinula frontata* Wallace
2. *Amaurornis phoenicura leucomelana* Mueller
3. *Irediparra gallinacea gallinacea* (Temminck)
4. *Gallus varius* Shaw & Nodd.
5. *Ypsilophorus ypsilophorus pallidior* Hartert
6. *Excalfactoria chinensis lineatula* Rensch
7. *Megapodius reinwardt reinwardt* Dumont
8. *Turnix maculosa everetti* Hartert
9. *Streptopelia chinensis tigrina* (Temminck)
10. *Geopelia striata maugea* (Temminck)
11. *Chalcophaps indica indica* (Linnaeus)
12. *Ducula aenea aenea* (Linnaeus)
13. *Ducula problematica* Rensch
14. *Treron curvirostra teyssmanni* (Schlegel)
15. *Ptilinopus dohertyi* Rothschild
16. *Ptilinopus melanocephalus melanocephalus* (Forster)
17. *Charadrius peronii* (Schlegel)
* 18. *Charadrius leschenaultii* Lesson
* 19. *Charadrius apricarius fulvus* (Gmelin)
* 20. *Tringa hypoleucus* Linnaeus

[1]) Boschbouwkundig Tijdschr. „Tectona", 23, p. 183 - 198, Buitenzorg 1930.

* 21. *Tringa glareola* LINNAEUS
* 22. *Calidris ruficollis* (PALLAS)
* 23. *Numenius phaeopus variegatus* (SCOPOLI)
* 24. *Numenius cyanopus* VIEILLOT
* 25. *Arenaria interpres* (LINNAEUS)
26. *Ardeola speciosa* (HORSFIELD)
27. *Ixobrychus sinensis* (GMELIN)
28. *Bubulcus ibis coromandus* (BODDAERT)
29. *Demiegretta sacra sacra* (GMELIN)
30. *Butorides striatus javanicus* (HORSFIELD)
31. *Egretta garzetta nigripes* (TEMMINCK)
32. *Egretta intermedia intermedia* (HASSELT)
33. *Notophoyx novaehollandiae novaehollandiae* (LATHAM)
34. *Anas gibberifrons gibberifrons* (MUELLER)
35. *Anas superciliosa percna* RILEY
36. *Dendrocygna arcuata* (HORSFIELD)
37. *Phalacrocorax melanoleucus* (VIEILLOT)
38. *Accipiter fasciatus tjendanae* STRESEMANN
39. *Haliastur indus intermedius* GURNEY
40. *Elanus caeruleus hypoleucus* GOULD
41. *Haliaëtus leucogaster* (GMELIN)
42. *Milvus migrans affinis* (GOULD)
43. *Circus assimilis assimilis* JARD. & SELBY
44. *Falco peregrinus ernesti* SHARPE
45. *Falco moluccensis renschi* SIEBERS
46. *Baza subcristata timorlaoënsis* MEYER
47. *Pandion haliaëtus cristatus* (VIEILLOT)
48. *Ninox fusca rudolfi* MEYER
49. *Tyto alba sumbaënsis* HARTERT
50. *Tanygnathus megalorhynchus sumbensis* MEYER
51. *Eclectus roratus cornelia* BONAPARTE
52. *Geoffroyus geoffroyi tjindanae* MEYER
53. *Trichoglossus ornatus fortis* HARTERT.
54. *Cacatua sulphurea citrinocristata* (FRASER)
55. *Rhyticeros everetti* ROTHSCHILD
56. *Eurystomus orientalis connectens* STRESEMANN
57. *Alcedo atthis floresiana* (SHARPE)
58. *Ceyx rufidorsus* STRICKLAND
59. *Halcyon australasia australasia* (VIEILLOT)
60. *Halcyon chloris chloris* (BODDAERT)
61. *Merops ornatus* LATHAM
* 62. *Merops superciliosus javanicus* HORSFIELD
63. *Caprimulgus affinis affinis* HORSFIELD
64. *Collocalia francica micans* STRESEMANN

65. *Collocalia esculenta sumbawae* Stresemann
* 66. *Cuculus optatus* Gould
67. *Cuculus poliocephalus lepidus* S. Mueller
68. *Eudynamis scolopacea everetti* Hartert
69. *Cacomantis variolosus sepulcralis* (S. Mueller)
70. *Centropus bengalensis sarasinorum* Stresemann
71. *Pitta brachyura maria* Hartert
* 72. *Hirundo rustica gutturalis* (Scopoli)
73. *Hirundo tahitica frontalis* Quoy & Gaimard.
74. *Hirundo daurica rothschildiana* Rensch
75. *Culicicapa ceylonensis connectens* Rensch
76. *Alseonax (latirostris) segregata* Siebers
77. *Terpsiphone paradisi sumbaënsis* (Meyer)
78. *Rhipidura rufifrons sumbensis* Hartert
79. *Myiagra ruficollis ruficollis* (Vieillot)
80. *Rhinomyias stresemanni* (Siebers)
81. *Erythromyias harterti* Siebers
82. *Graucalus sumbensis* Meyer
83. *Edoliosoma dohertyi* Hartert
84. *Lalaga nigra sueurii* (Vieillot)
85. *Geocichla dohertyi* Hartert
86. *Saxicola caprata francki* Rensch
87. *Acrocephalus stentoreus sumbae* Hartert
88. *Cisticola juncidis fuscicapilla* Wallace
89. *Megalurus timoriensis inquirendus* Siebers
* 90. *Phylloscopus borealis examinandus* Stresemann
* 91. *Lanius cristatus superciliosus* Latham
92. *Pachycephala pectoralis fulviventris* Hartert.
93. *Parus major cinereus* Vieillot
94. *Corvus coronoides timorensis* Bonaparte
95. *Dicrurus hottentottus sumbae* Rensch
96. *Oriolus chinensis broderipi* Bonaparte
97. *Artamus leucorhynchus celebensis* Brueggemann
98. *Artamus perspicillatus* Bonaparte
99. *Aplonis minor* (Bonaparte)
100. *Munia quinticolor* (Vieillot)
101. *Munia punctulata blasii* Stresemann
102. *Munia molucca propinqua* (Sharpe)
103. *Taeniopygia guttata guttata* (Vieillot)
104. *Amandava flavidiventris* (Wallace)
105. *Mirafa javanica parva* Swinhoe
* 106. *Anthus gustavi* Swinhoe
107. *Anthus novaezealandiae albidus* Stresemann
* 108. *Motacilla flava simillima* Hartert

109. *Philemon buceroides sumbanus* RENSCH
110. *Stigmatops indistincta limbata* (MUELLER)
111. *Myzomela erythrocephala dammermani* SIEBERS
112. *Anthreptes malacensis rubrigena* RENSCH
113. *Cinnyris solaris büttikoferi* HARTERT
114. *Dicaeum sanguinolentum wilhelminae* BUETTIKOFER
115. *Piprisoma obsoletum* (MUELLER)
116. *Zosterops wallacei* FINSCH
117. *Zosterops citrinella intercalata* STRESEMANN

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II. Ueber eine kleine Vogelsammlung von Bali.

Im September und Oktober 1928 sammelte Herr Taxidermist P. FRANCK mit einigen javanischen Präparatoren eine Reihe von Vögeln auf Bali, unter denen sich 5 für diese Insel bisher noch nicht bekannte Formen befanden. Hauptsammelplätze waren Gitgit (500 m) im Gebirge südlich des Hafenortes Boeleleng (wo zuvor schon W. DOHERTY, E. STRESEMANN und Verf. gesammelt hatten) und das Seraja-Gebirge im Osten der Insel.

1. *Podiceps ruficollis vulcanorum* RENSCH.

Batoe meringgit, 9.—10.X., 2 ♀ (Fl. 99; 100 mm; Culmen 23; 24,5 mm).

Der Kinnfleck ist sehr ausgedehnt, es handelt sich also um ein typisches Exemplar von *vulcanorum*. Neunachweis für Bali! — Die Ovarien waren stark geschwollen.

2. *Gallinula chloropus orientalis* (Horsfield).
Batoe meringgit, 9.X., 1 ♂ juv., 1 ♀ juv.
Erste Belegstücke dieser Rasse von Bali. Sie war schon von Stresemann an den Seen Danau Bujan und D. Bratan beobachtet worden (Novit. Zool., 20, p. 331, 1913). — Die Gonaden befanden sich im Ruhezustande.

3. *Gallus varius* (Shaw & Nodd.).
Batoe meringgit, 8.X., 1 ♀ juv.

4. *Turnix suscitator suscitator* (Gmelin).
Seraja, 1.X., 1 ♀. (Fl. 93 mm).
Ovar zum Teil grob granuliert.

5. *Treron curvirostra pulverulenta* Wallace.
Seraja, 1.X., 1 ♂. (Fl. 148 mm; Schw. 89 mm; Culmen —).
Die Testes waren stark geschwollen.

6. *Ixobrychus cinnamomeus* (Gmelin).
Batoe meringgit, 9.X., 1 ♂. (Fl. 145 mm; Schw. 40 mm; Culmen 50 mm).
Dieser Reiher war bisher noch nicht für Bali nachgewiesen worden. — Die Testes befanden sich im Ruhezustande.

7. *Anas superciliosa percna* Riley.
Batoe meringgit, 10.X., 1 ♂, 1 ♀.
Neunachweis für Bali! — Die Gonaden waren etwas geschwollen.

8. *Halcyon cyanoventris* (Vieillot).
Batoe meringgit, 6.X., 1 ♂ (Fl. 125 mm). Gitgit, 12.X., 1 ♀ juv.
Das ♀ mausert aus dem Jugend- in das Alterskleid. — Die Gonaden befanden sich im Ruhezustande.

9. *Merops superciliosus javanicus* Horsfield.
Seraja, 2.X., 1 ♂, 1 ♀.
Die Gonaden waren ein wenig geschwollen.

10. *Dryobates analis analis* (Bonaparte).
Seraja, 30.IX.—3.X., 1 ♂, 1 ♀.
Die Gonaden befanden sich im Ruhezustande.

11. *Dinopium javanense exsul* (Hartert).
Gitgit, 12.X., 1 ♂ (Fl. 131 mm; Schw. 80 mm; Culmen 128 mm).

12. *Cyanops armillaris baliensis* Rensch.
Batoe meringgit, 7.X., 2 ♂.
Masse und Färbung bestätigen diese jüngst aufgestellte Rasse: Fl. 96; 98 mm; Schw. 60,5; 60,5; Culmen 23; 24 mm. — Die Testes beider Exemplare waren etwas geschwollen.

13. *Xantholaema haemacephala rosea* (Dumont).
Gitgit, 13.X., 1 ♂ (Fl. 82 mm; Schw. 35 mm; Culmen 16 mm).

14. *Cuculus optatus* GOULD.
Batoe meringgit, 8.X., 1 ♀.

15. *Tachynaustes batasiensis infumata* (SCLATER).
Seraja, 2.X., 1 ♂. (Fl. 99 mm; Schw. 51 mm; Culmen 4,5 mm).
Dieser Palmsegler war bisher noch nicht von Bali bekannt. — Die Testes befanden sich im Ruhezustande.

16. *Hypothymis azurea prophata* OBERHOLSER $\gtrless$ *symmixta* STRESEMANN.
Batoe meringgit, 9.X., 1 ♀.
Die Stellung der balinesischen *Hypothymis* ist noch nicht geklärt. Offenbar handelt es sich um eine Uebergangsform, doch ist dies nach dem einen vorliegenden ♀ nicht eindeutig zu beurteilen. — Das Ovar war stark geschwollen.

17. *Rhinomyias olivacea olivacea* (HUME).
Gitgit, 12.X., 1 ♂ (Fl. 77 mm; Schw. 61 mm; Culmen — mm); 1 ♀ (Fl. 74 mm; Schw. 58 mm; Culmen 11,5 mm).
Diese beiden Exemplare (wie auch zwei von mir selbst auf Bali gesammelte Stücke) unterscheiden sich in keiner Weise von einem javanischen und einem sumatranischen Exemplare des Berliner Museums. Die Testes des ♂ waren stark geschwollen.

18. *Rhipidura javanica* SPARRMAN.
Seraja, 30.IX.—4.X., 2 ♂ (Fl. 77; 79 mm), 1 ♀ (Fl. 76 mm).
Die Testes der beiden ♂ waren geschwollen.

19. *Muscicapula melanoleuca hasselti* ROBINSON & KLOSS.
Batoe meringgit, 7.—9.X., 2 ♂, 2 ♀.
Die Gonaden aller Exemplare waren mehr oder minder stark geschwollen.

20. *Lalage nigra sueurii* (VIEILLOT).
Seraja, 30.IX., 1 ♂ juv.

21. *Pycnonotus goivier analis* (HORSFIELD).
Seraja, 29.IX., 1 ♀.

22. *Pycnonotus bimaculatus bimaculatus* (HORSFIELD).
Batoe meringgit, 8.X., 1 ♂ (Fl. 85 mm).
Die Testes waren etwas geschwollen.

23. *Criniger tephrogenys balicus* STRESEMANN.
Gitgit, 12.X., 1 ♂ (Fl. 110 mm; Schw. 96 mm; Culmen 17 mm).
Die Testes waren etwas geschwollen.

24. *Aegithina tiphia scapularis* (HORSFIELD).
Seraja, 30.IX.—4.X., 2 ?.
Beide Stücke sind etwas intensiver gelb als 5 verglichene westjavanische Exemplare.

25. *Saxicola caprata pyrrhonota* (VIEILLOT).
Batoe meringgit, 30.IX.—8.X., 1 ♂, 2 ♀.
Die Testes des ♂ waren stark geschwollen.

26. *Horeites montana montana* (Horsfield).
Batoe meringgit, 9.X., 1 ♀.

27. *Orthotomus sepium sepium* Horsfield.
Seraja, 4.X., 1 ♂, 1 ♀.

28. *Phylloscopus trivirgatus trivirgatus* Strickland.
Batoe meringgit, 7.X., 1 ♂.
Die Testes waren sehr stark geschwollen.

29. *Prinia familiaris* Horsfield.
Seraja, 1.X., 1 ♀.
Das Ovar befand sich im Ruhezustande.

30. *Megalurus palustris palustris* (Horsfield).
Batoe meringgit, 9.X., 1 ♂ (Fl. 95 mm; Schw. 110 mm; Culmen 16 mm).
Die Testes waren etwas geschwollen.

31. *Hemipus hirundinaceus* (Temminck).
Batoe meringgit, 7.X., 1 ♀.

32. *Lanius schach bentet* Horsfield.
Seraja, 30.IX., 1 ♀.
Das Ovarium war geschwollen.

33. *Pachycephala pectoralis javana* Hartert > *fulvotincta* (Wallace).
Batoe meringgit, 9.X., 2 ♂ (Fl. 82; 84 mm; Schw. 64; 66 mm; Culmen 15; 15 mm.

Die beiden Stücke stehen hinsichtlich der Ausdehung der braungelben Partie auf der Unterseite zwischen *javana* Hart. von O. Java und *fulvotincta* (Wall.) von Sumbawa und Flores, doch etwas näher zu *javana*. — Die Testes waren geschwollen.

34. *Parus major cinereus* (Vieillot).
Batoe meringgit, 7.X., 1 ♂.
Die Testes waren etwas geschwollen.

35. *Crypsirhina varians* (Latham).
Seraja, 2.X., 1 ♂ (Fl. 117 mm).
Die pigmentierten Testes waren etwas geschwollen.

36. *Oriolus chinensis maculatus* (Vieillot).
Seraja, 30.IX.,—2.X., 2 ♂, 2 ♀.
Die Gonaden aller Exemplare waren mehr oder minder geschwollen.

37. *Artamus leucorhynchus amydrus* Oberholser.
Seraja, 1.X., 1 ♀.
Das Ovar war ziemlich grob granuliert.

38. *Gracula javana javana* (Cuvier).
Gitgit, 12.—13.IX., 1 ♂ (Fl. 172 mm), 2 ♀ (Fl. 168; 172 mm).
Die Gonaden waren ein wenig geschwollen.

39. *Gracupica melanoptera tertia* HARTERT.
Seraja, 1.—2.X., 1 ♂, 2 ♀. — Batoe meringgit, 7.X., 1 ♀.
Die Gonaden waren nur wenig geschwollen.

40. *Aplonis panayensis gusti* STRESEMANN.
Seraja, 3.X., 1 ♀ (Fl. 97 mm).

41. *Motacilla cinerea caspica* (GMELIN).
Batoe meringgit, 8.X., 1 ♀.

42. *Cinnyris jugularis ornata* (LESSON).
Seraja, 30.IX.—4.X., 2 ♂, 2 ♀.
Die Testes waren geschwollen.

43. *Anthreptes malacensis malacensis* (SCOPOLI).
Seraja, 2.—4.X., 1 ♂, 1 ♂ juv.
Die Testes des ad. ♂ waren sehr stark geschwollen.

44. *Dicaeum trochileum trochileum* (SPARRMAN) $\lessgtr$ *stresemanni* RENSCH.
Seraja, 29.IX.—3.X., 1 ♂ (Fl. 55 mm), 1 ♀.
Das ♂ ist frisch vermausert, das ♀ mausert Schwingen und Schwanz. — Nach den Schnabelmassen (♂ 10 mm, ♀ 9,5 mm) zu urteilen, wären die balinesischen Stücke zur Nominatrasse zu rechnen, die Färbung des ♀ ist aber so hell wie bei den ♀ von Lombok, sodass eine intermediäre Bezeichnung die Verhältnisse am besten widergibt.

Die Angaben über den Zustand der Gonaden deuten darauf hin, dass viele Formen, für die ich selbst auf den Inseln Lombok, Sumbawa und Flores eine Brutperiode von April bis Juni feststellen konnte (besonders *Podiceps, Saxicola, Phylloscopus, Hypothymis, Muscicapula, Pachycephala, Anthreptes*), *am Ende der Regenzeit eine zweite Brutperiode* besitzen: von den behandelten Formen waren bei 25 die Gonaden geschwollen und davon bei 11 mehr oder minder stark.

III. Ueber eine Vogelsammlung von West-Flores.

Von dem äussersten Westen der Insel Flores waren bisher noch keine Vögel bekannt geworden, sodass die hier behandelte Kollektion, die von Dr. DE JONG und den ihn begleitenden javanischen Präparatoren im Herbst 1929 angelegt wurde, schon wegen der Fundorte von Interesse ist. Es befinden sich darunter ausserdem aber auch 4 interessante Neunachweise für diese Insel sowie eine neue Rasse. Auf der westwärts anschliessenden kleinen Insel Poeloe Rintja, von der ebenfalls noch keine Vögel bekannt sind, wurde leider nur eine Form gesammelt (*Taeniopygia guttata*).

1. *Amaurornis phoenicura leucomelana* (MUELLER).
Mboera, 22.X., 3 ♂ (Fl. 162; 166; 172 mm; Schw. 64; 65; 72 mm; Culmen 39; 38; 37 mm).
Es handelt sich um typisch gefärbte Exemplare dieser Rasse ohne Weiss an den Kopfseiten.

2. *Streptopelia chinensis tigrina* (TEMMINCK).
Mboera, 19.X., 1 ♂, 1 ♀.
3. *Geopelia striata maugea* (TEMMINCK).
Mboera, 18.X., 1 ♀ (Fl. 101 mm).
4. *Macropygia ruficeps orientalis* HARTERT.
Mboera, 26.X., 1 ♀ (Fl. 170 mm; Schw. 164 mm; Culmen 16,5 mm).
5. *Chalcophaps indica indica* (LINNAEUS).
Mboera, 22.X., 1 ♂ (Fl. 149 mm), 1 ♀ (Fl. 145 mm).
6. *Ducula aenea aenea* (LINNAEUS).
Laboean Badjo, 4.XI., 1 ♂ (Fl. 245 mm).
7. *Ptilinopus melanocephalus melanocephalus* (FORSTER).
Wai Sano, 16.XI., 1 ♂ (Fl. 115 mm; Schw. 71 mm; Culmen 13 mm).
8. *Tringa glareola* LINNAEUS.
Wai Sano, XI., 1 ♀.
Dieser Wintergast war bisher von Flores noch nicht bekannt.
9. *Ardea purpurea manillensis* MEYER.
Mboera, 26.X., 1 ♀ (Fl. 353 mm; Schw. 119 mm; Culmen 123 mm).
10. *Ardeola speciosa* (HORSFIELD).
Laboean Badjo, 6.XI., 1 ♂ (Fl. 213 mm).
11. *Anas superciliosa percna* RILEY.
Wai Sano, 13.—23.XI., 2 ♂ (Fl. 262; 260 mm; Schw. 90; 88,5 mm; Culmen 50; 50 mm).
12. *Accipiter fasciatus wallacii* (SHARPE).
Mboera, 20.X., 1 ♂, 1 ♀.
Beide Exemplare mauserten Schwingen und Steuerfedern.
13. *Falco moluccensis occidentalis* MEYER & WIGLESWORTH.
Mboera, 20.X., 1 ♂. — Wai Sano, 20.XI., 1 ♀.
Beide Stück mausern Schwingen und Steuerfedern.
14. *Geoffroyus geoffroyi floresianus* SALVADORI.
Wai Sano, 13.—14.XI., 2 ♂ (Fl. 158; 160 mm).
15. *Trichoglossus ornatus weberi* (BUETTIKOFER).
Mboera, 23.X., 1 ♂, 1 ♀. — Laboean Badjo, 8.XI., 1 ♂, 1 ♀. (♂ Fl. 127; 128; 129 mm; Schw. 98; —; 96 mm; Culmen 20; 20; 20 mm. — ♀ Fl. 123; 125; 132 mm; Schw. —; 96; 99 mm; Culmen 19; 19; 19 mm).

Das ♂ von Wai Sano zeigt eine sehr aufschlussreiche Farbaberration: die gelbgrünen Federn von Brust und Körperseiten weisen grossenteils ein 1½ bis 2 mm breites rötliches Band auf, dessen Färbung durch Zooerythrin bedingt ist. Damit nähert sich *Tr. weberi* den rotbrüstigen *Trichoglossus*-Formen. Die rotbrüstigen Formen bewohnen ja alle Inseln rings um Flores herum, und es schien unverständlich, dass auf dieser grossen und geologisch relativ alten Insel sich kein entsprechender geographischer Vertreter finden sollte. Bei der Bearbeitung der von mir selbst auf Flores erlegten Papageien kam ich bereits zu der

Ansicht, dass *Tr. weberi* (der von BUETTIKOFER als *Psitteuteles* beschrieben war) als geographischer Vertreter des *ornatus*-Rassenkreises anzusehen sei. Jetzt, nachdem ich die beschriebene Aberration gesehen habe, trage ich kein Bedenken, die Form sogar als normale Rasse einzubeziehen.

16. *Cacatua sulphurea occidentalis* (HARTERT).
Mboera, 18.X., 1 ♂ (Fl. 228 mm), 1 ♀ (Fl. 220 mm).
Die Iris ist auch bei dem Männchen als rot bezeichnet: doch handelt es sich vielleicht um eine falsche Geschlechtsangabe.

17. *Eurystomus orientalis connectens* STRESEMANN.
Mboera, 18.X., 1 ♀ (Fl. 190 mm). — Wai Sano, 17.XI., 1 ♀ (Fl. 197 mm).

18. *Alcedo atthis floresiana* SHARPE.
Mboera, 22. X., 1 ♀ (Fl. 72 mm; Schw. 30 mm; Culmen 34 mm).

19. *Halcyon chloris chloris* (BODDAERT).
Mboera, 19.—23.X., 2 ♀ (Fl. 113; 114 mm; Schw. 71; 72 mm; Culmen 45; 44 mm).

20. *Halcyon sancta sancta* VIGORS & HORSFIELD.
Mboera, 18.X., 1 ♂. — Laboean Badjo, 7.XI., 1 ♂.

21. *Rhamphalcyon capensis floresiana* (SHARPE).
Mboera, 19.X., 1 ♂. — Laboean Badjo, 3.XI., 1 ♂. (Fl. 149; 148 mm; Schw. 92; 92,5 mm; Culmen 75; 75 mm).

22. *Monachalcyon fulgidus gracilirostris* RENSCH.
Wai Sano, 14.—15.XI., 2 ♂ (Fl. 137; 138 mm; Schw. 119; 118 mm; Culmen vom Vorderrand des Nasenloches bis zur Spitze 37; 38,5 mm), 1 ♀.
Die kantige Schnabelform und die Masse bestätigen die kürzlich aufgestellte floresische Rasse.

23. *Micropus pacificus pacificus* (LATHAM).
Mboera, 18.X., 1 ♀.
Dieser australische Zugvogel war bisher noch nicht von Flores nachgewiesen worden.

24. **Collocalia francica dammermani** nov.
Mboera, 19.X., 1 ♂.
Diagnose. Von der nächstverwandten *C. francica vestita* (LESSON) von Sumatra und Java unterschieden durch bräunlichere Unterseite, stärker bräunlichere Kopfseiten und etwas helleren Bürzel. Die Tarsen sind an der Aussenseite befiedert. Fl. 108 mm; Schw. 48,5 mm; Tiefe der Schwanzgabelung (Differenz zwischen der Länge der inneren und äusseren Steuerfedern) 9 mm; Culmen 5 mm. Iris dunkelbraun; Schnabel schwarz; Füsse dunkel graubraun, Krallen schwarz.

Typus: das beschriebene Exemplar im Zoologischen Museum zu Buitenzorg.

Von diesem Rassenkreise war bisher noch kein Vertreter von den Kleinen Sunda-Inseln bekannt.

25. *Merops superciliosus javanicus* Horsfield.
Laboean Badjo, 30.X., 1 ♂, 1 ♀.

26. *Cuculus optatus* Gould.
Mboera, 18.—26.X., 1 ♂, 1 ♂ juv., 1 ♀ juv.
Dieser Wintergast wurde bisher nur erst einmal — von Wallaces Assistenten Allen — auf Flores erlegt.

27. *Cacomantis variolosus sepulcralis* (Mueller).
Wai Sano, 14.XI., 1 ♂. (Fl. 115 mm; Culmen 16,5 mm).
Der *C. variolosus*-Rassenkreis war bisher auf dem Sundabogen ostwärts nur bis Sumbawa bekannt.

28. *Eudynamys scolopacea malayana* Cabanis & Heine.
Wai Sano, 18.XI., 1 ♂ juv. (als ♀ bezeichnet).

29. *Dryobates nanus grandis* (Hargitt).
Mboera, 16.—19.X., 2 ♀ (Fl. 84; 86 mm). — Wai Sano, 15.XI., 1 ♂ (Fl. 85 mm).

30. *Pitta brachyura concinna* Gould.
Mboera, 29.X., 2 ♂ (Fl. 102; 104 mm; Schw. 36; 37 mm; Culmen 21; 22 mm). — Laboean Badjo, 8.XI., 1 ♀ (Fl. 102 mm; Schw. 39 mm; Culmen 20 mm).

31. *Culicicapa ceylonensis sejuncta* Hartert.
Wai Sano, XI., 1 ♂ (Fl. 58 mm; Schw. 45 mm; Culmen 9 mm), 1 ♀ (Fl. 54 mm; Schw. 41 mm; Culmen 8 mm).

32. *Rhipidura diluta diluta* Wallace.
Mboera, 16.X., 1 ♀. (Fl. 75 mm; Schw. 82 mm; Culmen 12,5 mm).

33. *Gerygone sulphurea sulphurea* Wallace.
Mboera, 20.X., 1 ♂. — Wai. Sano, XI., 1 ♂. — Laboean Badjo, XI., 1 ♂. (Fl. 50; 50; 51 mm; Schw. 33; 34; 35 mm; Culmen 9; 9; 9 mm).

34. *Hypothymis azurea symmixta* Stresemann.
Mboera, 17.—24.X., 2 ♂.

35. *Terpsiphone paradisi floris* Buettikofer.
Laboean Badjo, 30.X.—1.XI., 2 ♂, 2 ♀. — Wai Sano, 16.XI., 1 ♂. (♂ Fl. 94; 97; 98; 99 mm; Schw. 308; 334; 298; 388 mm; Culmen 19; 18; 19 19 mm. — ♀ Fl. 91; 98 mm; Schw. 122; 106 mm; Culmen 18; 18 mm).
Bei einem ♂ sind die weissen Schwanzfedern schwarz gesäumt; Steuerfedern und Schwingen haben ausserdem rotbraune Phaeomelaninflecke (vergl. das bei *T. p. sumbaënsis* Gesagte.

36. *Erythromyias dumetoria dumetoria* (Wallace).
Wai Sano, 18.XI., 1 ♂. (Fl. 62 mm; Schw. 44 mm; Culmen 11 mm).

37. *Graucalus floris floris* (Sharpe).
Mboera, 17.X., 1 ♂.

38. *Pericrocotus lansbergi* BUETTIKOFER.
Mboera, 16.X., 1 ♂. — Wai Sano, XI., 1 ♂, 1 ♀. (♂ Fl. 71; 72 mm; Schw. 86; 91 mm; Culmen 11; — mm. — ♀ Fl. 72 mm; Schw. 89 mm; Culmen 10,5 mm).

39. *Lalage nigra sueurii* (VIEILLOT).
Laboean Badjo, XI., 1 ♂ (Fl. 92 mm; Schw. 72 mm; Culmen —).

40. *Orthnocichla everetti everetti* HARTERT.
Wai Sano, XI., 4 ♂ (Fl. 55,5; 55; 53,5; 53 mm; Culmen 13,5; 14; 14; 14,5 mm), 1 ♀ (Fl. 51,5 mm; Culmen 12 mm).
Mit Sumbawa-Vögeln verglichen (Rasse *sumbawana* RENSCH) sind auch diese Stücke deutlich unterschieden durch braunere Kopfseiten und röteren Oberkopf.

41. *Geocichla interpres interpres* (TEMMINCK).
Wai Sano, 15.—22.XI., 2 ♂ (Fl. 109; 109 mm; Schw. 57; 60 mm; Culmen 17,5; 18 mm), 1 ♀ (Fl. 105 mm; Schw. 61 mm; Culmen 18 mm).

42. *Saxicola caprata pyrrhonota* (VIEILLOT).
Mboera, 16.—18.X., 2 ♂, 1 ♂ juv. — Laboean Badjo, XI., 1 ♂, 1 ♀. (♂ Fl. 69; 70; 74 mm; Schw. 49; 51; 55 mm; Culmen 11; 11,5; 12 mm. — ♀ Fl. 69 mm; Schw. 49 mm; Culmen 11 mm).

43. *Cisticola juncidis fuscicapilla* WALLACE.
Mboera, 19.X., 1 ♀. — Wai Sano, XI., 1 ♀.

44. *Cisticola exilis lineocapilla* GOULD.
Wai Sano, 13.XI., 1 ♂. (Fl. 47 mm; Schw. —; Culmen 10 mm).

45. *Phylloscopus borealis examinandus* STRESEMANN.
Wai Sano, XI., 1 ♂, (Fl. 73 mm; Schw. 51 mm; Culmen 11 mm), 1 ♀ (Fl. 67,5 mm; Schw. 47 mm; Culmen 11 mm).

46. *Lanius cristatus superciliosus* (LATHAM.
Laboean Badjo, 6.XI., 1 ♂, 1 ♀.

47. *Pachycephala pectoralis fulvotincta* WALLACE.
Mboera, 20.—21.X., 1 ♂, 1 ♀. — Wai Sano, XI., 1 ♂. — Laboean Badjo, XI., 2 ♂, 1 ♀ (♂ Fl. 76; 78; 80 mm; Schw. 57; 61; 62 mm; Culmen 15; 14; 15 mm. — ♀ Fl. 76; 77 mm; Schw. 57; 59 mm; Culmen 13; 14 mm).

48. *Parus major cinereus* VIEILLOT.
Mboera, 17.—21.X., 3 ♂. — Wai Sano, XI., 1 ♂. (Fl. 64; 65; 66; 67 mm; Schw. —; 59; 57; 61 mm; Culmen 9; —; —; 9,5 mm).

49. *Corvus coronoides timorensis* BONAPARTE.
Mboera, 27.X., 1 ♂.

50. *Corvus florensis* BUETTIKOFER.
Mboera, 23.—25.X., 1 ♂ (Fl. 231 mm; Schw. 167 mm; Culmen vom Vorderrand der Nasenlöcher an 33 mm), 1 ♀ (Fl. 227 mm; Schw. 170 mm; Culmen 30 mm).
Diese eigentümliche Art, die nichts mit *C. enca* zu tun hat, ist offenbar

auf das Tiefland beschränkt — ein Vorkommen, das an dasjenige von *Leucopsar rothschildi* STRES. auf Bali erinnert.

51. *Dicrurus hottentottus bimaënsis* WALLACE.

Mboera, 16.—20.X., 3 ♂. — Laboean Badjo, 3.XI., 1 ♀. — Wai Sano, 19.XI., 1 ♂. (♂ Fl. 141; 140; 140 mm; Schw. 114; 113; 111; 113 mm; Culmen 27; 26; 26; 25,5 mm).

Die Masse rechtfertigen die Abtrennung der deutlich grösseren Lombok-Rasse *vicinus* RENSCH.

52. *Oriolus chinensis broderipi* WALLACE.

Mboera, 17.—19.X., 2 ♂, 2 ♀. — Laboean Badjo, 3.—7.XI., 2 ♂, 1 ♀. (♂ Fl. 162; 160; 158; 156 mm; Schw. 108; 111; 103; 103 mm; Culmen 34; 37; 34; 36 mm).

53. *Artamus leucorhynchus celebensis* BRUEGGEMANN.

Wai Sano, 21.XI., 1 ♂. — Laboean Badjo, 1.XI., 1 ♂.

54. *Gracula venerata mertensi* RENSCH.

Laboean Badjo, 8.XI., 1 ♀. — Wai Sano, 16.XI., 1 ♀. (Fl. 165; 170 mm; Schw. 76,5; 80 mm; Culmen 33; 32 mm).

Die Masse und der rötlichgrüne Schiller der Bauchfedern bestätigen die Abtrennung dieser Rasse.

55. *Munia quinticolor* (VIEILLOT).

Mboera, 22.X., 1 ♂, 1 ♀.

Beide Exemplaren haben eine dunkelbraune Kehle, das ♂ hat auch dunkelbraune Oberschwanzdecken. Sie gleichen damit ganz den als *wallacei* SHARPE bezeichneten Stücken von Lombok, die also nicht als geographische Rasse anerkannt werden kann.

56. *Munia molucca propinqua* (SHARPE).

Laboean Badjo, 30.X., 1 ♂, 1 ♀.

57. *Taeniopygia guttata guttata* (VIEILLOT).

Laboean Badjo, XI., 2 ♀. — Poeloe Rintja, 7.XI., 2 ♀, 4 juv.

58. *Amandava flavidiventris* (WALLACE).

Wai Sano, XI., 2 ♂ juv.

Beide Stücke mausern vom Jugend- in das Alterskleid. Oberseits treten dabei die ersten roten Federn als Superciliarstreifen auf.

59. *Mirafra javanica parva* SWINHOE.

Laboean Badjo, XI., 1 ♂. (Fl. 70 mm; Schw. 11,5 mm; Culmen 46 mm).

60. *Motacilla flava simillima* HARTERT.

Wai Sano, XI., 1 ♂ juv. —.

Das Exemplar mausert vom Jugend- ins Alterskleid.

61. *Philemon buceroides neglectus* (BUETTIKOFER).

Mboera, 17.X., 1 ♀ (Fl. 139 mm). — Laboean Badjo, 7.XI., 1 ♂ (Fl. 142 mm).

62. *Anthreptes malacensis convergens* RENSCH.
Mboera, 21.X., 1 ♂ (Fl. 67 mm), 1 ♀ (Fl. 61 mm). — Wai Sano, XI., 1 ♂ (Fl. 68 mm).

63. *Cinnyris jugularis ornata* LESSON.
Laboean Badjo, 30.X., 1 ♂.

64. *Cinnyris solaris degener* HARTERT.
Mboera, 19.—24.X., 3 ♂. — Wai Sano, XI., 1 ♂. — Laboean Badjo, XI., 1 ♂. (Fl. 51; 51; 52; 52; 54 mm).

65. *Dicaeum igniferum igniferum* WALLACE.
Mboera, 24.X., 1 ♂. — Wai Sano, XI., 5 ♂, 3 ♀. (♂ Fl. 50; 50; 51; 52; 52,5; 53 mm; Schw. 24; 24; 25; 26; 26; 25 mm; Culmen 9; 9,5; 9; 10; 9,5; 9 mm. — ♀ Fl. 48; 49; 50 mm; Schw. 23; 23; 23 mm; Culmen 9,5; 10; 10 mm).

66. *Acmonorhynchus annae annae* BUETTIKOFER.
Wai Sano, XI., 1 ♂ (Fl. 58 mm; Schw. 31,5 mm; Culmen 9 mm), 1 ♀ (Fl. 54 mm; Schw. 28,5 mm; Culmen 9 mm), 2 ♂ juv.

67. *Zosterops wallacei* FINSCH.
Mboera, 22.X., 1 ♀ (Fl. 54 mm). — Wai Sano, XI., 1 ♂ (Fl. 55 mm).

68. *Zosterops chloris sumbavensis* GUILLEMARD.
Laboean Badjo, 30.X., 1 ♂ (Fl. 56 mm; Schw. 39 mm; Culmen 11,5 mm).

69. *Oreosterops dohertyi subcristata* HARTERT.
Wai Sano, XI., 1 ♂ (Fl. 64 mm; Schw. 49 mm; Culmen 12 mm).

IV. Liste einer Vogelausbeute von Reo an der Nordkuste von West-Flores.

Die Vögel wurden 1911 von einem javanischen Präparator gesammelt. Sie sind wegen des Fundortes und wegen eines Neunachweises von Interesse.

1. *Accipiter novaehollandiae sylvestris* WALLACE, 1 ♂, 1 ♀. — Die Schwingen mausern.

2. *Falco moluccensis occidentalis* MEYER & WIGLESWORTH, 1 ♀.

3. *Falco cenchroides* VIGORS & HORSFIELD, 1 ♀ (als ♂ bezeichnet), Fl. 247 mm; Schw. 151 mm. — Erster Nachweis dieser Art aus dem Gebiete der Kleinen Sunda-Inseln (offenbar Irrgast). STRESEMANN machte darauf aufmerksam (Nov. Zool., 21, p. 78, 1914), dass alle bisher als Irrgäste im Archipel erlegten *F. cenchroides* Weibchen seien. Auch das vorliegende Stück entspricht dieser eigentümlichen Regel.

4. *Falco longipennis hanieli* HELLMAYR, 1 ? (Fl. 244 mm). — Schwingen und Steuerfedern mausern.

5. *Cacatua sulphurea occidentalis* (HARTERT), 1 ♂, 1 ♀.

6. *Trichoglossus ornatus weberi* (BUETTIKOFER), 1 ?.

7. *Eudynamys scolopacea malayana* CABANIS & HEINE, 1 ♂.

8. *Gracula venerata mertensi* RENSCH, 2 ♂ (Fl. 165; 170 mm).

9. *Philemon buceroides neglectus* (BUETTIKOFER), 1 ♂, 1 ♀.

FISH EGGS AND LARVAE FROM THE JAVA SEA [1])

by

Dr. H. C. DELSMAN

(Laboratorium voor het Onderzoek der Zee, Batavia).

18. The genus Cybium,

with remarks on a few other Scombridae.

Determination of the number of myotomes is a valuable expedient — too little made use of thus far — in identifying the pelagic larvae of fishes and, by means of these, the eggs from which they hatch. The efficiency of this method is, however, limited by three difficulties. As a matter of fact the total number of myotomes in the larva corresponds fairly well to the number of vertebrae in the adult. Generally it is not easy, indeed, to determine exactly which is the last myotome in the tail, the limits becoming gradually less distinct. But this first difficulty is the least serious of the three, as approximate determination is quite possible and proves fairly reliable.

The determination of the foremost myotomes is, as a rule, not difficult. More exact results, therefore, could be obtained in this direction, if we could rely on the constancy of the number of trunk, i.e. pre-anal, myotomes and vertebrae, i.e. if the place of the anus should be fixed. We have repeatedly seen, however, that this is by no means the case. In clupeid fishes we have found it to be a general rule that the anus moves forward, often over a fairly considerable distance, during the metamorphosis of the larva into the young fish. By this process the number of trunk segments increases and that of the tail segments decreases at the same rate. On the reverse, we have seen that in the genus *Trichiurus* a similar backward shifting of the anus during development takes place. Thus the evidence afforded by counting the number of trunk myotomes in the larva must be handled with caution. Its results are more or less reliable only in combination with different other considerations.

A third difficulty in identifying fish larvae by means of the number of myotomes is afforded by the fact that there are large groups of fishes in which the number of vertebrae shows, if any, only an insignificant variation. In herring-like and eel-like fishes, with a relatively high number of vertebrae, the variations may be considerable and may be found even between closely related species. In marine percoid and related fishes, however, the number of vertebrae and myotomes is fairly well fixed, being as a rule about 10 + 15. It seems, therefore, a hopeless task to identify the various eggs and larvae of these fishes by means of this feature.

[1]) cf. Treubia Vol II, p. 97, Vol III, p. 38, Vol V, p. 408, Vol VI, p. 297, Vol VIII, p. 199 and p. 389, Vol IX, p. 338, Vol XI, p. 275, Vol XII, p. 37 and 367 and Vol XIII, p. 217.

A group of fishes which gives more hope of success in this respect is that of the Scombriformes, comprising the Carangidae, Scombridae, Trichiuridae and a few smaller families. The number of vertebrae is often fairly high and subject to considerable variations. As a matter of fact, for the genus *Caranx* 10—14 seems to be characteristic, for the higher forms, such as *Caranx gallus*, as well as for the more elongated species. In different species of *Chorinemus* I counted 10—15 or 16. These numbers deviate very little from those found in percoid fishes.

For the Scombridae and Echeneidae, however, I found in:

Elacate nigra	11 + 14 = 25
Echeneis naucrates	14 + 16 = 30
Scomber kanagurta, neglectus	13 + 18 = 31
Euthynnus thunnina	19 + 19 = 38
Cybium commersonii	20 + 25 = 45
Cybium kuhlii	20 + 25 = 45
Cybium guttatum	20 + 25 = 45
Cybium lineolatum	21 + 29 = 50

In the Trichiuridae, finally, these numbers are:

Lepidopus caudatus 41 + 70 - 73 = 110 - 113 (STRUBERG, 1918)

Trichiurus sp. div. 30 - 40 + 115 - 131 = 155 - 167.

We have dealt with the latter family in a previous article (Treubia, Vol. IX, p. 338) and will occupy ourselves now with the Scombridae only. In this group of rapid pelagic swimmers the number of vertebrae tends to increase, and at the same time the anus tends to shift backward. The pelvic bones, however, remain directly attached to the cleithra, as has been shown by TATE REGAN [1].

Only in the Trichiurids this direct connection gets lost and at the same time the pelvis itself, together with the ventral fins, gets rudimentary or disappears altogether. Where it is still present, as in *Lepidopus*, the connection consists of a long ligament.

The sheerfishes, belonging to the genus *Cybium* Cuv., or *Scomberomorus* Lacépède, are represented in the Java Sea by several species, all known as tengiri (malay). They are fairly large-sized fishes, regularly to be found at the fish market and much appreciated by their consumers. One of the commonest species is *Cybium guttatum* which seems to frequent the neighbourhood of the river mouths. Evidently it is closely related to the so-called spanish mackerel, *Cybium maculatum* of Cuvier, *Scomberomorus maculatus* Mitchill of most later authors. This is found as well along the Atlantic as along the Pacific coast of tropical America [2]. Its eggs and early development have been carefully studied and described about half a century ago by JOHN A. RYDER [3])

[1]) C. TATE REGAN, 1909, On the Anatomy and Classification of the Scombroid fishes. Ann. Mag. Nat. Hist. Vol. III (8th series).

[2]) cf. MEEK and HILDEBRAND, 1923, The Marine Fishes of Panama, Part I p. 325.

[3]) RYDER, J.A. 1882, Development of the Spanish Mackerel (*Cybium maculatum*) Bulletin U.S. Fish Commission, Vol I, for 1881.

who succeeded in carrying out artificial fertilization. He pointed out that spawning finds place at night, as I have found to be the case with many Indian species also. At the same time he gives us the solution of the problem why artificial fertilization of the eggs of tropical seafishes has yielded so little success thus far. The supposition that the fishes mentioned above have fully ripe eggs only against night seems to be obvious. This supposition is confirmed by RYDER's experience: only at night did he succeed in obtaining artificial fertilization. Regarding the eggs of the japanese mackerel (*Scomber japonicus*). KAMIYA [1]) observes: "By the continuous collection of the natural eggs, the spawning-time was found to be strictly confined from sunset to sunrise, with its height between sunset and midnight".

In the Java Sea, along the coast and especially near rivermouths, we may fairly regularly find an egg showing a great resemblance to the one described for *Cybium maculatum* by RYDER. I was struck by this resemblance, however, only after I had independently come to the conclusion that this egg belonged to *Cybium guttatum*.

I had arrived at this conclusion i.a. by the method of counting the myotomes of the larva, a method neglected by RYDER as well as by most later workers on the development of pelagic fish eggs. And I thought my conclusion satisfactorily confirmed when the egg of *Cybium guttatum* proved to bear such a close resemblance to that of *Cybium guttatum*.

The egg of *Cybium guttatum* has, as a rule, a diameter of 1,1—1,2 mm, that of *Cybium maculatum*, according to RYDER, a diameter of $^1/_{25}$ to $^1/_{20}$ inch = 1,0—1,27 mm. Practically speaking therefore these values coincide. The egg contains an oil-globule of which the diameter may vary from 0.3 to nearly 0.4 mm, whereas in the egg of *Cybium maculatum*, according to RYDER, it hardly surpasses 0.25 mm (0.01 inch).

Sometimes, however, I have found bigger eggs, with a bigger oil-globule. They seem to occur especially in river mouths where the water is more or less brackish. So in the mouth of the Sampit (Borneo) I found the diameter of the egg to vary from 1,13 to 1,26 mm, that of the oil-globule being 0,45 mm. In the mouth of the Koemai (Borneo) these values were 1,24—1,32 and 0,5 resp. and near Bengkalis (Sumatra) I found even eggs with a diameter of 1,36 mm and an oil-globule of 0,56 mm. The salinities in these three places were 26‰, 25,5‰ and 23‰ resp. So not only the diameter of the egg but also that of the oil-globule seems to increase when the salinity of the water gets lower. The dimensions given first were those of eggs fished in water with a salinity of 30—32‰, near Cheribon (Java), Bagan Si Api Api and Amphitrite Bay (Sumatra). I once found three eggs with a diameter as low as 1,05 mm in water with a salinity of 32,8‰ (near Tandjong Bobos, north coast of Java, Sept. 20th, 1929). So we easily come to the conclusion that the size of the egg depends on the salinity of the water, increasing or decreasing in proportion to the latter getting lower or higher. The same phenomenon has been

[1]) Journal Imp. Fisheries Institute Vol. 21, p. (30), 1925.

observed in other pelagic eggs, the eggs of the Baltic Sea fishes e.g. being bigger than the corresponding eggs of the North Sea. The same phenomenon will probably be observed in other eggs from the Java Sea also. So I have described in nr. 14 of this series (Treubia Vol. IX, p. 37) two *Pellona* eggs differing in hardly any respect but their size. The eggs are often found together with those of *Cybium,* occurring in the same localities. The smaller one was ascribed by me to *Pellona elongata,* the bigger one to the closely allied *P. amblyuroptera.* Considering the salinity of the water in which they were found, we see that the smaller egg occurred in water with a salinity of 29,2 ‰ —29,6 ‰, the bigger one was found near Bagan (Sumatra) in water of 28,8 ‰ and afterwards in great numbers in the Kumai (Borneo) in water of 25,5 ‰ (Sept. 30th and Oct. 1st, 1930). Here the diameter of the eggs (without the gelatinous coat) amounted to 1,6—1,8 mm. On the other hand I found the smaller eggs afterwards in water of 34,2—34,4 ‰ (near Sumatra and Gresik, October 3rd and 6th, 1930). Here the diameter was 1,44—1,5 mm (without gelatinous coat). I feel inclined now to ascribe these variations no longer to a specific difference, but to the influence of the salinity. In the light of this it seems to me more doubtful than ever whether *Pellona elongata* and *amblyuroptera* are to be considered as separate species or as variations only.

The same probably holds good, partly at least, for the eggs of *Cybium guttatum,* but, as we shall see further on, we may not lose sight of the possibility that among the eggs mentioned in this article there may be also some which belong to other species of *Cybium.*

The egg of *Cybium guttatum* was found in great quantities fairly high up the river Kumai (Borneo) towards the end of the east monsoon (Sept.-Oct.), together with the above-mentioned eggs of *Pellona elongata* or *amblyuroptera,* and with the eggs of *Stolephorus baganensis.* During the east monsoon the whole lower part of that river is flooded with seawater, and sea fishes, especially *Cybium guttatum* and *Pellona* spp, are caught then by the inhabitants of the village of Kumai, situated about 12 miles from the mouth.

Fig. 1. Egg from the Kumai (Borneo), fished off the village of Kumai, September 29th, 1930, 11 a.m. × 26.

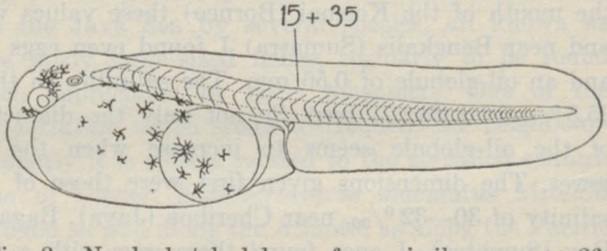

Fig. 2. Newly hatched larva from similar egg, × 26.

The *Cybium* eggs fished in the morning (fig. 1) all show a young embryo with the tail growing out. Black pigment spots are present on the left and

right sides of the trunk of the embryo and on the dorsal surface of the yolk (so in fig. 1 they are seen through the yolk, not on the surface exposed to the observer).

The colourless oil-globule is situated ventrally. Branching black pigment spots are present on the inner half of the oil-globule, i.e. the side turned towards the yolk (so, in fig 1 they also are seen through the oil-globule). Yellow pigment dots, too, were observed now and then.

As a rule hatching occurs in the course of the afternoon. A few times, however, I saw these eggs hatch during the morning already.

The newly hatched larva is represented in fig. 2. The young larvae again offer a great resemblance to those shown by RYDER for the Spanish mackerel. A certain likeness to the larvae of *Trichiurus,* described by me in nr. 11 of this series, cannot be denied either. A fairly high number of myotomes, especially in the tail, is characteristic of both groups of larvae. In *Cybium* indeed the number is not nearly so high as in *Trichiurus*. I counted 14 myotomes in the trunk and about 35 in the tail, thus

$$15 + 35 = 50$$

whereas in the adult *Cybium guttatum* the number of vertebrae is

$$20 + 26 = 46$$

As a rule in newly hatched fish larvae we could count a few more tail myotomes than in larvae of 1 or 2 days old. Here also in slightly older larvae no more than 33 tail myotomes could, as a rule, be counted. I got the impression that also the number of trunk myotomes showed a slight decrease in these latter stages, the total number not surpassing 13 or 14. So in a larva of 3 days old I counted

$$13 + 33 = 46$$

which tallies with the total number of vertebrae in the adult.

Such a slight decrease of the number of trunk vertebrae during the first

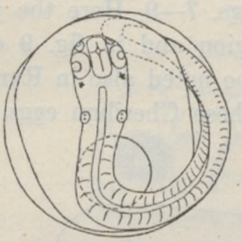

Fig. 3. Egg from Amphitrite Bay (Sumatra), immediately before hatching, November 22th, 1923, 8.30 a.m. × 26.

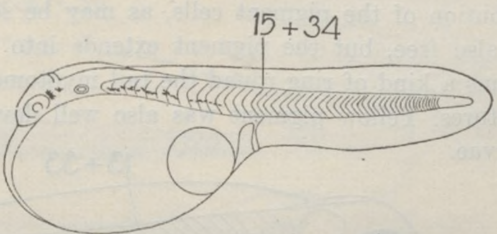

Fig. 4. Newly hatched larva from similar egg, × 26.

days after hatching was observed by me in *Trichiurus* also. Afterwards, however, it is followed by a backward movement of the anus causing the number of trunk myotomes to increase and that of the tail myotomes to decrease. If now we compare the numbers of vertebrae in the adult *Cybium guttatum*

with the numbers of myotomes in the larva we see that also in *Cybium* the anus moves backward, just as we found this to be the case in *Trichiurus*. In the latter genus we stated a backward shifting over a distance corresponding to about 10 myotomes, in *Cybium guttatum* to 6 or 7 myotomes. This gives us reason to suggest that, whereas a forward shifting of the anus during larval development is characteristic of the clupeiform fishes (cf. nrs. 2, 4, 7, 8, 10, 12, 13, 14, 15 and 17 of this series), a backward shifting of the anus is equally typical of the Scombroid fishes, at least of the more elongated forms.

Returning to the larva of fig. 2 we see that, just as in the egg, branching black pigment cells are present on the upper surface of the yolk and also of the oil-globule. On the head too a few similar pigment cells are present in front of and behind the eyes. No pigment is to be found in the tail. During further development pigmentation does not increase, the black pigment cells of the yolk surface gather at the inferior border of the trunk myotomes.

The description given above applies especially to the eggs fished in the Kumai and Sampit (Borneo). The eggs fished near the mouths of the Rokan and the Indragiri and near Bengkalis (Sumatra) do not show the branching black pigment cells on the dorsal part of the yolk but only a row of small pigment cells along the trunk myotomes, as shown by figs. 3—6. The surface of the yolk is practically free of pigment.

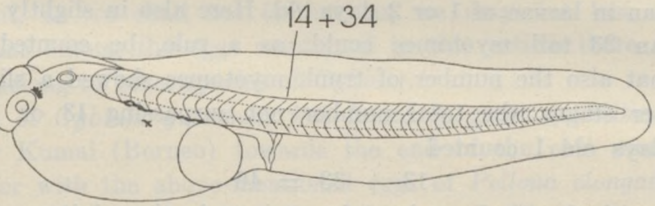

Fig. 5. Larva in the evening of the same day. × 26.

Eggs fished near Cheribon (Java) show again a somewhat different distribution of the pigment cells, as may be seen from figs. 7—9. Here the yolk is also free, but the pigment extends into the tail region and in fig. 9 even forms a kind of ring round the tail myotomes as may be noted also in RYDER's pictures. Yellow pigment was also well developed in these Cheribon eggs and larvae.

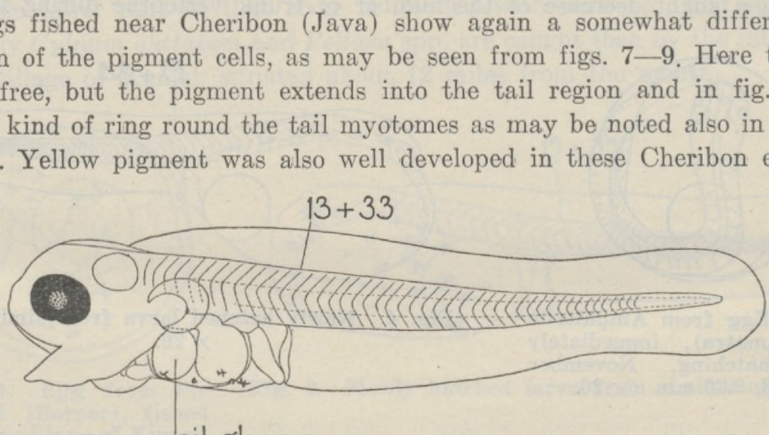

Fig. 6. Larva of the second morning after hatching. × 26.

The stage in which the eyes are black is reached about two days after hatching. The yolk has been practically resorbed then, but not the oil-globule.

Besides *Cybium guttatum* a few other species of *Cybium* are taken regularly in the Java Sea. I counted the number of vertebrae in the following species for which I found:

Cybium guttatum	$20 + 26 = 46$
Cybium commersonii	$20 + 25 = 45$
Cybium kuhlii	$20 + 25 = 45$
Cybium lineolatum	$21 + 29 = 50$

The four species show no great differences in the numbers of vertebrae. May be the eggs will not differ very much from each other either. As mentioned above, I have observed certain variations in the pigmentation of the newly hatched larvae. It is not impossible that these larvae, partly at least, belong

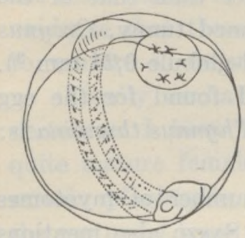

Fig. 7. Egg from the Bay of Cheribon (Java), April 27th, 1929, 8 a.m. × 26.

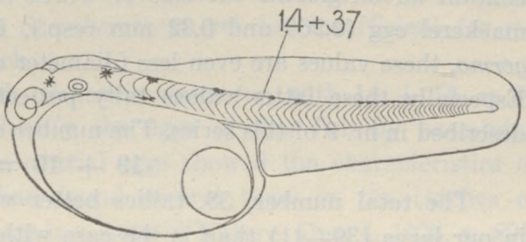

Fig. 8. Newly hatched larva from similar egg, 11 a.m. × 26.

to different species and that part of the differences shown by the eggs themselves must be explained in the same way. In Bagan Si Api Api e.g. *Cybium kuhlii* is the commonest species and one might therefore ask if not the egg and larvae of figs. 3—6 belong to this and those of figs. 7—9 to another species again. At present, however, we cannot get a definite answer to these questions.

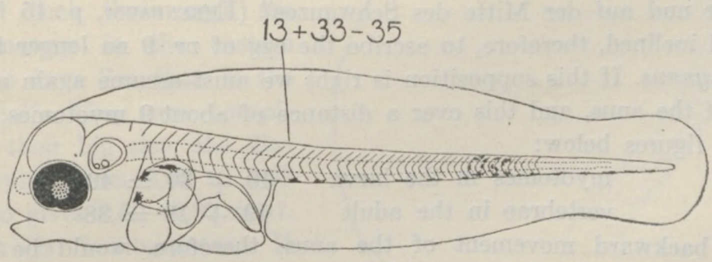

Fig. 9. Larva of the second morning after hatching. × 26.

What about the related genus *Scomber*? The Indian species of this genus have the same number of vertebrae as the European *Scomber scombrus,* viz. $13 + 18 = 31$. These species (*Scomber kanagurta, neglectus*) are fairly common in Indian waters and one might expect to find their eggs earlier or later in the catches of the egg net. Indeed, I have shown in nr. 9 of this series (Treubia Vol. VIII, p. 395) an egg which I ascribed to *Scomber kanagurta.* There was, indeed, one difficulty: the number of myotomes in the larva proved to be about

10 higher than the number of vertebrae in the adult. It was especially the number of tail myotomes which was higher than one might expect and this made me write already at that time: "this incongruity is apt to throw serious doubt on the correctness of our identification".

Since then, another possibility has occurred to me, viz. that the egg of nr. 9 should not belong to *Scomber* but to *Thynnus thunnina*, the tongkol. The latter also is caught regularly along the coast of Bawean (cf. nr. 9), be it not with the pajang-net but with hooks dragged behind fast-sailing outrigged canoes. SANZO [1]) has shown that the eggs of the big mediterranean tunny have about the same diameter (1—1,12 mm) as the eggs of the so much smaller mackerel (± 1,1—1,2 mm, according to SELLA and CIACCHI [2]), and contain an oil-globule the size of which is slightly smaller than that of the mackerel egg (0,265 and 0,32 mm resp.). For the long-finned tunny, *Orcynus germo*, these values are even less (diameter of egg 0,9, of oil-globule 0,24 mm [3]). Especially these latter values tally perfectly with what I found for the egg described in nr. 9 of this series. The number of vertebrae in *Thynnus thunnina* is:

$$19 + 19 = 38$$

The total number, 38, tallies better with the total number of myotomes in our larva (39—41) than is the case with *Scomber* (31). SANZO also mentions that he has counted 39 segments in the larva of *Orcynus thynnus*, 39—40 in that of *Orcynus germo*. For the number of vertebrae of these two species PARMA [4]) gives 39 and 40 resp. I was struck especially by the similarity in pigmentation of the tunny larva and our larva. In nr. 9 of this series (p. 397) I wrote: "I found a pair of yellow pigment spots close behind the eyes, another pair at a slight distance behind the otocysts, about the anterior myotomes, a third pair near the anus and one more about the middle of the tail". In the newly hatched tunny larva SANZO found: „je zwei gelbe Pigmentflecke vor und hinter den Augen sowie hinter den Gehörblasen, ferner über dem After und auf der Mitte des Schwanzes" (EHRENBAUM, p. 15 [5]).

I feel inclined, therefore, to ascribe the egg of nr. 9 no longer to *Scomber* but to *Thynnus*. If this supposition is right we must assume again a backward shifting of the anus, and this over a distance of about 9 myotomes, as follows from the figures below:

myotomes in the larva	$10 + 30 = 40$
vertebrae in the adult	$19 + 19 = 38$

The backward movement of the anus, therefore, would be greater in *Thynnus* than in *Cybium* where it amounts to 6—7 myotomes only. This is

[1]) L. SANZO, 1929. Uova e larve di tonno (*Orcynus thynnus* LTKN). Rendiconti della R. Academia Nazionale dei Lincei, Vol. IX, p. 104.

[2]) M. SELLA and O. CIACCHI, 1925, Uova e Larva dello Sombro del Mediterraneo (*Scomber scomber* LINN.). R. Comitato Talassografico Italiano, Memoria CXIV. For the egg of *Scomber japonicus* KAMIYA (1925 l.c.) gives a diameter of 0,93—1,15 mm.

[3]) L. SANZO, 1925, Uova e larve di Alalonga (*Orcynus germo* LTKN). Rendiconti R. Acc. Naz. Lincei, Vol. I, p. 131.

[4]) C. PARMA, 1919, Il tonno e la sua pesca. R. Comitato Thalassigrafico Italiano, Memoria LXVIII.

[5]) E. EHRENBAUM, 1924, Scombriformes, in Report Danish Oceanographical Expeditions 1908—1910 to the Mediterranean. Vol. II.

not exactly what one might have expected in view of the fact that the total number of vertebrae is lower in *Thynnus* than in *Cybium*. A smaller backward shifting would have answered our expectations better. Let us hope that future investigations on the numbers of myotomes in fish larvae, also in Europe and other parts of the world, will bring us nearer to the solution of this apparent incongruity.

Taking into consideration what we have found for *Trichiurus, Cybium* and *Thynnus,* we may expect a similar backward movement of the anus in the larvae of *Scomber*. In the adult fish the number of vertebrae is $13 + 18 = 31$. Thus in the larva we might expect something like $10 + 22 = 32$ myotomes. Among the numerous pelagic eggs from which I have reared the larvae there are some indeed in which the latter have similar numbers of myotomes, but the evidence that these eggs belong to *Scomber* is as yet too insufficient for me to venture to describe them as such.

Finally we have the sucker-fish, *Echeneis naucratus,* with $14 + 16 = 30$ vertebrae. I have been able to identify the eggs of this fish by examining quite mature females, in which the ovarial eggs showed the characteristics of certain planktonic eggs which I had found several times in the catches of the egg net. I have mentioned this egg in a note in Nature, Dec. 4, 1926, p. 805. The identification has been confirmed by a paper of SANZO (1927) [1]) who, in the Red Sea, found quite similar eggs and has identified them as belonging to *Echeneis naucrates* in exactly the same way as I did. Moreover, SANZO had more success than I in rearing the larvae from these eggs. As far as I know, however, he has not given any figures yet.

Fig. 10 shows an egg fished May 16th, 1924, at 11 a.m., south of Bawean (salinity 31 ‰). Generally speaking I have the impression that these eggs are more numerous in the eastern half of the Java Sea than in the western half. They are conspicuous by their big size, the diameter varying from 2,45 to 2,65 mm (SANZO gives 2,50—2,60 mm). The yolk is homogeneous. It contains a relatively small yellow oil-globule, with a diameter of 0,16 mm. The embryo itself also looks yellow through the presence of numerous, densely-crowded, yellow pigment cells. Also black pigment cells are to be found, especially in the head region, behind the eyes.

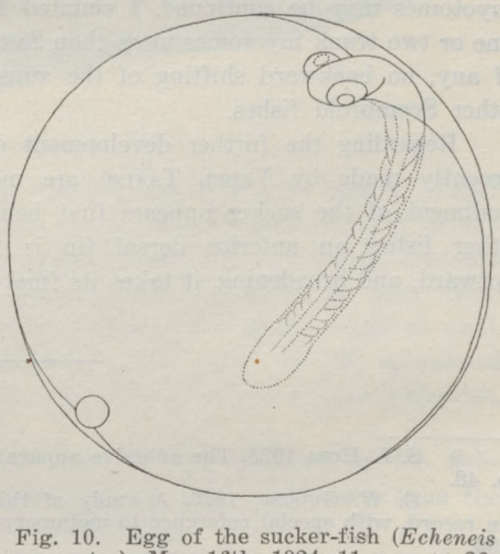

Fig. 10. Egg of the sucker-fish (*Echeneis naucrates*). May 16th, 1924, 11 a.m. × 26.

[1]) L. SANZO, 1927, Uova e larva di *Echeneis naucrates*. R. Comitato Thalassografico Italiano, Memoria CXXXIII.

The next day, at 11 a.m., the embryo has reached a length of 180° and the heart is beating, at a rate of 180 pulsations per minute.

As mentioned above, I have never succeeded in having these eggs hatched, however numerous my efforts. I suppose this is due to the high temperature of the water. In my rearing glasses, on board, the temperature of the water in the afternoon gets higher than in the sea and I fear the sucking fish eggs do not stand this. As the distribution range of *Echeneis naucrates* extends northward as far as Japan and Korea, I suppose the temperature of the tropical seas will be near the maximum at which the eggs can develop.

They gradually sink to the bottom of the glass and do not hatch. A few times I have freed the larva artificially but then it did not stretch itself completely. From such a larva, with the anterior part of the body bent, I made the reconstruction shown in fig. 11.

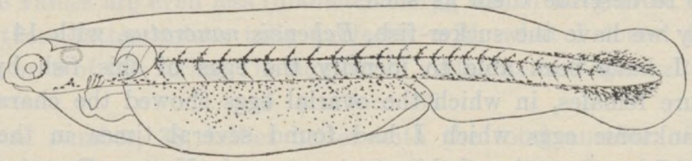

Fig. 11. Reconstruction after a curved larva which was artificially liberated from the egg membrane. × 13.

The number of myotomes could not be determined with great accuracy in my curved larvae. According to SANZO, who gives a description of his larvae which tallies very well with mine, 16 tail myotomes and about 14 trunk myotomes may be continued. I counted 14 tail myotomes only and probably one or two trunk myotomes more than SANZO did. At any rate it is evident that, if any, no backward shifting of the anus occurs in *Echeneis* as we found in other Scombroid fishes.

Regarding the further development of the sucker-fish [1]) the statements recently made by VEDEL TANING are most interesting. He shows that the rudiment of the sucker appears first behind the head at the place where in other fishes an anterior dorsal fin is found, and that, gradually moving forward, and broadening, it takes its final position on the head above the eyes.

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[1]) S. L. HORA 1925, The adhesive apparatus of the sucker fish, Nature, Vol CXV, p. 48.

E. W. GUDGER, 1926, A study of the smallest shark-suckers (*Echeneididae*) on record, with special reference to metamorphosis. American Museum Novitates, nr. 234.

A. VEDEL TANING, 1926, Position du disque céphalique chez les Echénéides au cours de l'ontogénèse. Comptes rendus Ac. Sciences Paris, t. 182.

L. SANZO, 1927, Uova e larva di *Echeneis naucrates*. R. Comitato Thalassografico Italiano, Memoria 133.

L. SANZO, 1928, Uova e larva di *Remora remora*, ibid, Memoria 138.

SOME NEW OR RARE FISHES OF THE INDO-AUSTRALIAN ARCHIPELAGO

by

DR. J. D. F. HARDENBERG.

(Laboratorium voor het Onderzoek der Zee, Batavia).

Family **CLUPEIDAE.**

COILIA GRAY.

Coilia lindmani BLKR. (fig. 1).

B 9—10, D I—13, A 78—80, P 16, V 7, L.l. 57—58, L.v. 9—10.

Elongate and compressed. Height 4,6—5, head 4,8—5,1 in length without tail. Snout prominent, somewhat shorter than eye, which goes 4,4 in head. Maxillary narrow, extending beyond root of pectoral, with small, rather

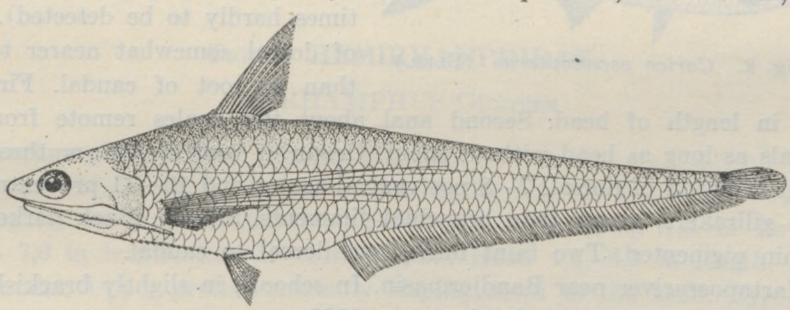

Fig. 1. *Coilia lindmani* BLKR.

irregular teeth. Dorsal about two times nearer to snout than to base of caudal. The distance origin of dorsal-snout about 2½ in the distance origin of dorsal-caudal. The ventrals are situated somewhat behind origin of dorsal. Distance ventralia-suboperculum 1,3—1,6 in distance ventralia-origin of anal. Anal 1,7—1,8 in length. Six free pectoral rays, reaching far behind origin of anal. 13—14 proventral scutes and 21—24 postventral ones. 29—32 spinulated gillrakers, shorter than eyes. Teeth on jaws and palatines. Colour yellowish, back dark.

Three specimens, of resp. 210, 155 and 175 mm, obtained at the fish-market at Palembang on Sept. 24th 1929. BLEEKER got his specimen from the same locality. They seem to be fairly abundant here.

Literature:

1. *Coilia lindmani* BLEEKER. Act. Soc. Scient. Indo. Neerl. III 1858. Zesde bijdrage tot de kennis van de vischfauna van Sumatra p. 48.

2. *Coilia lindmani* BLEEKER. Tijdschrift voor de Dierkunde II 1863. Sixième notice sur la faune ichthyologique de Siam p. 176 (only the name is given).
3. *Coilia lindmani* GÜNTHER. Cat. Brit. Mus. VII 1868 p. 415.
4. *Coilia lindmani* BLEEKER. Atlas Ichthyol. VI 1872 p. 139.
5. *Coilia lindmani* VOLZ. Natuurkundig Tijdschrift voor Nederlandsch Indië. Deel 66 1906 p. 208.
6. *Coilia lindmani* WEBER and DE BEAUFORT. The fishes of the Indo Australian Archipelago II 1923 p. 49.

CORICA HAM BUCH.

Corica pseudopterus (BLKR.) (fig. 2).

B. 5, D. 16, A. 15—16+2, P. 13—14, V. 8, C. 17, L.l. 37—39, L.v. 9—10.

Height 4,2—4,5 in length, 5,2—5,5 with caudal. Head 4,0—4,2, 5,2—5,5 with caudal. Eye 2,8—3 in head, about equal to or somewhat longer than snout and about equal to postorbital part of head. One or two ridges on vertex. Maxillary reaching beyond the first fourth or third part of pupil, about twice in head or more. Minute teeth on jaws, palatines and tongue. (Sometimes hardly to be detected). Origin of dorsal somewhat nearer to snout than to root of caudal. First anal 1,7—2 in length of head. Second anal about two scales remote from first. Pectorals as long as head without snout. Origin of ventrals two or three scales in front of origin of dorsal. 7—8 postventral scutes and 10—11 proventral ones. 23—24 gillrakers, longer than branchial filaments. Silvery. Back darker. Nose and chin pigmented. Two faint lines from dorsal to caudal.

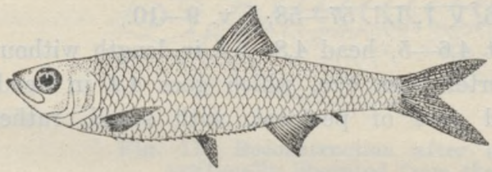

Fig. 2. *Corica pseudopterus* (BLKR.)

Martapoerariver near Bandjermasin. In schools, in slightly brackish water. 21 specimens 25—64 mm. October 4th, 1928.

From Sumatra I got a few specimens which were different in some points from those of Borneo (Bandjermasin). In the following description I will give the characteristics in which they differ.

Height 3,8 in length, 4,8 with caudal. Eye 3,3 in head, about equal to snout and shorter than postorbital part. Origin of ventrals one or two scales before origin of dorsal.

Three specimens of about 4,5 cm from Soensang at the mouth of the river Moesi, in brackish water. They were found in a sample of *Stolephorus*. September 23th 1929.

Through the kindness of Mr. L. COOMANS DE RUITER at Pontianak, I got in July 1930 three more specimens of 4—4.5 cm from the Padang Tikarbay in front of the mouth of one of the affluents of the Kapuasriver, therefore near the localities of BLEEKER. They agree exactly with the description given by him. They have the same measurements. The maxillary reaches to the frontborder of the eye only and the position of the dorsal is also the same

as given by BLEEKER, its origin being somewhat nearer to the caudal than to the snout, whereas in the specimens from Bandjermasin and Soensang the maxillary is longer (see above) and the position of the dorsal is nearer to the snout than to the caudal.

From the above we see, that specimens from several localities may have some differences in the position of the dorsal fin, in the size of the eye and in the height of the body. As the differences are not very great I think they may be ascribed to the existence of local races or varieties. The Sumatra-specimens have a smaller eye and a higher body than those from Borneo. The animals from Bandjermasin as well as from Sumatra have the dorsal fin more forward than the Pontianak-specimens, which are the only ones, which agree exactly with the type description.

1. *Spratella pseudopterus* BLEEKER. Nat. Tijdschr. Ned. Ind. III 1852 p. 432.
2. *Clupeoides pseudopterus* GÜNTHER. Cat. Brit. Museum. VII 1868 p. 452.
3. *Corica pseudopterus* BLEEKER. Atl. Ichth. VI. p. 98 1872.
4. *Clupeoides pseudopterus* VAILLANT. Nouv. Arch. Mus. Hist. Nat. V. 1894 p. 100.
5. *Corica pseudopterus* WEBER and DE BEAUFORT. The fishes of the Indo Australian Archipelago II 1913 p. 54.

Family **HEMIRHAMPHIDAE.**

ARRHAMPHUS GÜNTHER.

Arrhamphus brevis (SEALE) (fig. 3).

D. 16—17, A. 15, V. I. 5, P. I. 11, C. 15, L.l. 57—58, L.v. 9—10.

Slightly compressed, the breadth of the body going 1,3 in its height. Height 7,0 in length, 8,3—8,5 with caudal. Head 4,2—4,3 in length, 5,1—5,3 with caudal. Upper profile gradually sloping down to the head. Eye 3,4—3,7 in head, 1,1—1,3 in interorbital space, 1,2—1,4 in snout. Teeth tricuspid, 4—5 rows in lower and 5—6 rows in upper jaw. Triangular part of upper jaw, formed

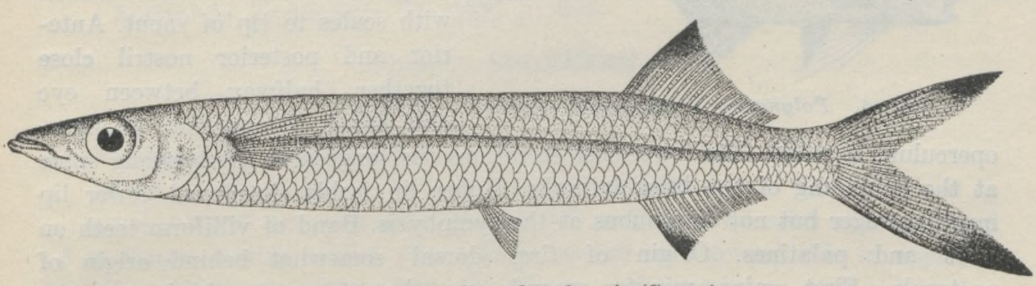

Fig. 3. *Arrhamphus brevis* (SEALE).

by intermaxillaries, broader than long. Lower jaw projecting by about the length of ⅓—¼ of the eye beyond snout. A projection of the skin forms a symphysial knob. Origin of anal opposite to third ray of dorsal. Thirty-six scales between dorsal and occiput. Dorsal and anal concave, the anterior rays

being the longest. Pectorals 1,5—1,6 in head. Ventrals 2,5—2,7 in head. Origin of ventral about midway between origin of caudal and eye. Caudal forked. Lower lobe longest. Sides with a silvery narrow band, bordered above by a dark line. Anterior rays of dorsal and outermost rays of anal tipped with black. Top of anal and dorsal tips of caudal black.

Two specimens of 205 and 240 mm bought at the fishmarket at Tandjong Pinang (Riouw Archipelago). October 9th 1929. Out of a sample of *Hemirhamphus quoyi* C. V.

The description given above agrees perfectly with that by SEALE. The bigger specimen has the lower jaw not projecting beyond the snout. As my specimens are bigger than those described by SEALE and by WEBER and DE BEAUFORT the projecting lower jaw seems to shorten with age.

Literature:

1. *Oxyporhamphus brevis* SEALE. Philippine Journal of Science IV 1909 p. 495.
2. *Arrhamphus brevis* WEBER and DE BEAUFORT. The fishes of the Indo Astralian Archipelago IV 1922 p. 172.

Family **POLYNEMIDAE.**

POLYNEMUS L.

Polynemus sextarius BL. SCHN. (fig. 4).

D^1. VIII, D^2. I—13, A. III—12, P. I—13 + 6, V. 1—5, C. 17, L.l. 49, L.h. 5—1—10.

Height 3,3 in length, 4,4 with caudal. Head 3 in length, 4 with caudal. Eyes 3,6 in head, 2 in postorbital part, and equal to interorbital space. Eyes covered with a gelatinous membrane, which forms a flap on the praeoperculum. Mouth reaching to behind eye. Maxillaries not scaly, 2,6 in head. Head covered with scales to tip of snout. Anterior and posterior nostril close together, halfway between eye and snout. Hindborder of praeoperculum serrated. The lowermost serrations the longest. A short strong spine at the beginning of the linea lateralis. Upper lip feebly developed, lower lip much stronger but not continuous at the symphysis. Band of villiform teeth on jaws and palatines. Origin of first dorsal somewhat behind origin of pectorals. First spine minute, second one the strongest, third one the longest, about as long as postorbital part of head. Origin of second dorsal behind anus. Spine of second dorsal less than half as long as the third one of first dorsal, about as long as third spine of anal. First and second anal spine small. Vertical fins scaly. Caudal deeply forked with pointed lobes. Pectoral as long as the distance middle of eye-hindborder of the operculum. The two

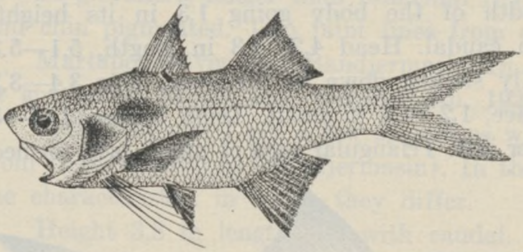

Fig. 4. *Polynemus sextarius* BL. SCHN.

upper free pectoral filaments are of equal length and are the longest, reaching to the middle of ventrals. Ventrals 1,5 in pectorals. The first ray somewhat prolonged.

Distance between origin of ventrals and origin of anal is somewhat more than postorbital part of head. Scales with a finely spinulated hindborder. Colour of the formaline specimens yellowish. Back and head finely pigmented with black. An oval black blotch at the beginning of the lateral line, about 8 scales long. Inner side of operculum black which, by the transparency of the latter, is conspicuous also from the outside. Fins yellowish, pigmented with black, with the greatest density at the hindborder of the two dorsals and of the caudal.

A single specimen of 100 mm taken in a fish-trap at the mouth of the Paneiriver, October 6th 1929, a single specimen of 69 mm from Kuala Lumpur, Malacca (January 1929) and one specimen of 92 mm caught near the mouth of the Kapuasriver (14-9-1930), Borneo. I received this latter specimen through the courtesy of Mr. L. COOMANS DE RUITER, Pontianak.

Literature:

1. *Polynemus sextarius* BLOCH-SCHNEIDER. Syst.Ichth. 1801 p. 18.
2. *Polynemus sextarius* BLEEKER. Verh. Bat. Gen. XXII 1849. Bijdrage Percoiden p. 59.
3. *Polynemus sextarius* CANTER. Journ. Asiat. Soc. Royal. XVIII 1850, p. 1014.
4. *Polynemus sextarius* GÜNTHER. Cat. Brit. Mus., II 1860 p. 326.
5. *Trichidion sextarius* BLEEKER. Ned. Tijdsch. Dierk. II 1865 p. 174.
6. *Polynemus sextarius* DAY. Fishes of India 1878—1888 p. 177.
7. *Polynemus sextarius* VOLZ. Natuurkundig Tijdschrift voor Nederlandsch Indië. Deel 66. 1906 p. 89.
8. *Polynemus sextarius* GILCHRIST and THOMSON. Ann. South Afric. Mus. VI 1908 p. 179.
9. *Trichidion sextarius* JORDAN and STARKS. An. Carnegy Mus. XI 1917. p. 455.
10. *Polynemus sextarius* WEBER and DE BEAUFORT. The Fishes of the Indo-Australian Archipelago IV 1922 p. 210.

Family **SOLEIDAE.**

TYPHLACHIRUS nov.gen. [1]

Typhlachirus caecus nov.spec. (fig. 5).

D. 63, C. 12, A. 42, V. 3, P. dextr. 3, P. sinister 6, L.l. 105.

Oval. "Eyes" on right side. Height 2,2 in length, 2,5 with caudal. Head 4,3 in length, 5 with caudal. One tubular nostril on coloured side in upperlip. Nostril on blind side remote from lip. Upper- and lowerlip on each side rather densely fringed with tentacles. Only one more or less inconspicuous, rudimentary eye on right side, situated near corner of mouth in the upperlip, surrounded

[1]) First I proposed to give this genus the name *Cryptops* but Prof. C. L. HUBBS, Michigan, was so kind to inform me that this name was preoccupied. He suggested me to use the name *Typhlachirus* instead.

by tentacles. The whole snout on blind side densely covered with small tentacles. Hindborder of operculum fringed on blind side. Mouth subterminal. Distance tip of snout corner of mouth 2,6 in head. Lateral line straight from a point of the head to the tail on which it is continued. On the head it runs with a right angle upwards and then curves strongly forwards. It disappears gradually near the tip of snout. The blind side too has a lateral line. Scales

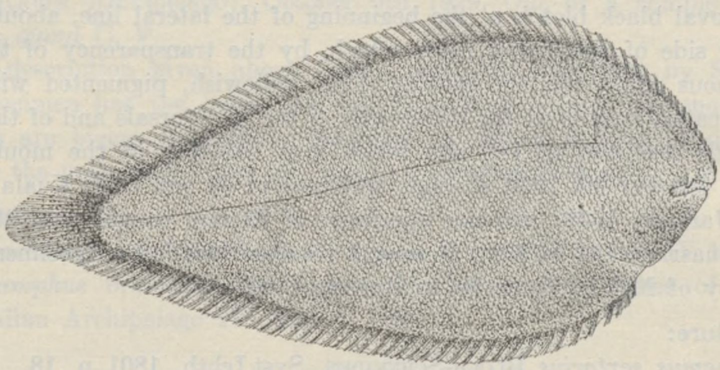

Fig. 5. *Typhlachirus caecus.*

ctenoid on each side, covered with skin. Those on coloured side larger than on blind side. The scales on coloured side are smallest in the middle, above and beneath lateral line. Towards dorsal and anal fin they become gradually bigger. The biggest are on the head. The scales on the vertical fins are smaller again. Border of fins not scaly. 19—20 scales between lateral line and dorsal fin. Vertical fins confluent. Dorsal and anal have on blind side the rays ciliated. Right pectoral minute, in upper corner of gill-opening. Left pectoral short with a broad base, confluent with a cutaneous fold of the operculum. Right ventral connected with anal. Left ventral free, its underside ciliated.

Brownish above. Dorsal and anal darker, with a hyaline border. Caudal hyaline.

The description given above is made from the type specimen of 106 mm. My other specimens differ only slightly from the type. So the height goes 2—2,2 and the head 4—4,3 in length without caudal. Also the numbers for the finrays and linea lateralis differ only one or two from the numbers given above. In one specimen of 140 mm the central part of caudal is blackish too. I got 5 specimens of 98—140 mm, near Bagan Si Api Api (Strait Malacca) in brackish and very muddy water, three specimens in January 1928 and two other ones in October of the same year. All specimens are mature. In three of the five specimens a minute eye-rudiment can be detected on the head hidden beneath the scales and tentacles. In the two other ones only the spot of the rudiment can be found, as the rudiment itself is lacking. I have called the species *caecus* with reference to the fact, that the animals are evidently blind.

This fish is most probably allied to the genus *Synaptura*. Perhaps *Synaptura lipophthalma* KAROLI (Termeszetrajzi füzetek V 1882 p. 30) is closely allied

species. In its description the right pectoral is said to be wanting. I think it fairly probable that it is as minute as in my specimens and therefore is easily overlooked.

Family **GOBIIDAE.**

TRYPAUCHEN C. V.

Trypauchen microcephalus BLKR. (fig. 6).

B. 4, D. VI—54, A. I—44, P. 16, V. 5, C. 17, L.l. 64, L.v. 14.

Elongated and compressed. Height 8,5 in total length (7,2 without tail). Head 8,4 in total length and 7,1 in length without tail. (According to BLEEKER 8,5). Its height 1,3 and its breadth about twice in its length. Breadth of the body 1,8 in its height. Crista on head smooth. Eyes minute, situated between first and second fourth part of head. Mandibles a little longer than maxillae. Chin somewhat prominent. On prae- and suboperculum, on the lower jaw and on the top of the head there are one to two rows of pores (see fig.). Head and chest without scales. Distance snout-anus about twice in distance anus-caudal.

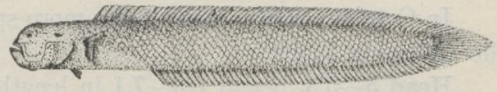

Fig. 6. *Trypauchen microcephalus* BLKR.

Vertical fine continuous and hyaline. Caudal pointed bluntly, 7 in total length. Ventrals situated somewhat in front of pectorals. Connected with each other for about three fourth of their length.

Colour uniform pink. I found one specimen in a fish-trap in the neighbourhood of Seneboei near Bagan Si Api Api (Sumatra), January 1929. Total length 9.5 cm.

This species lives in the same muddy regions as the more common *Trypauchen vagina.*

Literature:

1. *Trypauchen microcephalus* BLEEKER. Dertiende bijdrage tot de kennis der vischfauna van Borneo.
   Act. Soc. Sc. Indo-Neerl. VIII 1860 p. 62.
2. *Trypauchen microcephalus* GÜNTHER. Catalogue of fishes III 1861 p. 17.
3. *Trypauchen microcephalus* BANKS. Eighteenth report on the Sarawak Museum 1927 p. 31.

TRYPAUCHENICHTHYS BLKR.

Trypauchenichthys sumatrensis nov.spec. (fig. 7).

B. 4, D. V—37, A. I—38, P. 15, V. 4, C. 17, L.l. 40, L.v. 8.

Head 5,3, height 6,3 in length without tail. Breadth of the body 1,8 in its height. Height of the head 1,2 in its length. Its breadth 2 in its length and 1,8 in its height. Eyes minute, situated above corner of mouth, between first and second fourth of

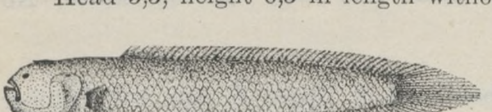

Fig. 7. *Trypauchenichthys sumatrensis.*

the head. Mouth crescentic, sub-terminal. A row of canine-like teeth of moderate length in each jaw. As in *Tyrpauchen* a cavity above the operculum. Crista on the head rather elevated, faintly serrated, covered by skin. Its first strong teeth pointed forward. Two rows of pores on prae- and suboperculum and on the lower jaw. Also some pores near the eyes and on top of head.

Vertical fins continuous. Pectorals situated in lower half of body. Ventrals inserted below or somewhat in front of pectorals, entirely free from each other. Two outer rays by far the longest. First ray stronger than the others. Caudal pointed, about 6 in total length.

Colour uniform pink. Fins in fresh specimens somewhat blackish.

I got one specimen caught in July 1922 near Bagan Si Api Api. Total length 6,3 cm.

In October 1929 I found three more specimens. Their examination furnished the following figures:

Head 5—5,3, height 6,3—7,1 in length. Height of head 1,2—1,4, its breadth 1,5—2 in its length.

D. V—38—41, A. I—34—38, L.l. 38—40.

This species has the same habitats as *Trypauchen vagina* and *Trypauchen microcephalus*. I suppose it may be found in front of the other rivermouths of Sumatra too.

PSEUDOTRYPAUCHEN nov.gen.

Pseudotrypauchen multiradiatus nov.spec. (fig. 8).

B. 5, D. VII—29, A. I—28, V. 5, P. 40, C. 17, L.l. 50, L.tr. 8.

Head 7,0 in total length, 5,6 without tail. Height of the body 1 in length of head, 7 in total length. Breadth of the body 2 in its height. Height of head 1 in its length. Tail 3,3 in total length. Pectorals reaching to anus, 5,5 in total length, 3,7 without tail. Ventrals reaching to anus, inserted in front of pectorals. The innermost as well as the outermost rays are connected, the total forming a disk. The innermost rays are the longest. Vertical fins continuous.

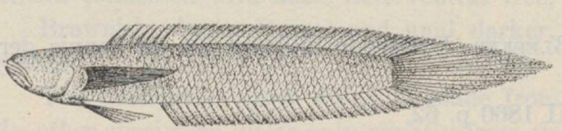

Fig. 8. *Pseudotrypauchen multiradiatus.*

Eyes minute, concealed beneath skin, situated in second fourth of the head. Mouth large, terminal, reaching far behind eye, about half of the head. Jaws provided with small, regular, teeth. No prominent chin. Gillopenings not confluent with each other, large. Head and body entirely scaled. No pores visible on the head.

Colour pale rosa.

I got two specimens in the neighbourhood of Bagan Si Api Api, October 4th 1929. The type specimen, described above, measured 7,2 cm. The other specimen had its tail damaged. Length without tail 5,0 cm.

In a collection from the same locality made in July 1922, I found three more specimens of about the same lengths. They all had their tails damaged.

Their proportions were the same as shown by the type-specimen. For the finformula and linea lateralis I found as follows:

D. VII—30—33, A. 28—33, P. 38—41, L.l. 50.

I found this species mixed with *Trypauchen vagina*. It seems therefore to have the same mud-burrowing habits. I think the species can be found in other rivermouths of Sumatra too. I have called the genus *Pseudotrypauchen* as the animals resemble specimens of *Trypauchen* very much and the species-name refers to the numerous rays of the pectoral fin. It has no cavity in the nape.

In a collection from the same locality made in July 1932, I found three more specimens of about the same lengths. They all had their tails damaged.

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I got one specimen caught in July 1929 near Bagan Si Api Api. Total length 6.3 cm.

In October 1929 I found three more specimens. Their examination furnished the following figures.

Head 5—5.8, height 6.3—7.1 in length. Height of head 1.2—1.4, its breadth 1.5—2 in its length.

D. V—38—41, A. I—34—38, l.l. 38—40.

This species has the same habitats as *Trypauchen vagina* and *Trypauchen microcephalus*. I suppose it may be found in front of the other rivermouths of Sumatra too.

PSEUDOTRYPAUCHEN nov. gen.

Pseudotrypauchen multiradiatus nov. spec. (fig. 8).

B. 5, D. VII—29, A. I—28, V. 5, P. 40, C. 17, L.l. 50, L.tr. 8.

Head 7.0 in total length, 5.6 without tail. Height of the body 1 in length of head, 7 in total length. Breadth of the body 2 in its height. Height of head 1 in its length. Tail 3.3 in total length. Pectorals reaching to anus, 5.5 in total length, 3.7 without tail. Ventrals reaching to anus, inserted in front of pectorals. The innermost as well as the outermost rays are connected, the total forming a disk. The innermost rays are the longest. Vertical fins continuous.

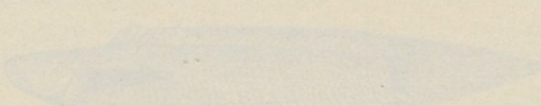

Fig. 8. *Pseudotrypauchen multiradiatus.*

Eyes minute, concealed beneath skin, situated in second fourth of the head. Mouth large, terminal, reaching far behind eyes, about half of the head. Jaws provided with small, regular teeth. No prominent chin. Gill-openings not confluent with each other, large. Head and body entirely scaled. No pores visible on the head.

Colour pale rosa.

I got two specimens in the neighbourhood of Bagan Si Api Api, October 4th 1929. The type specimen, described above, measured 7.3 cm. The other specimen had its tail damaged. Length without tail 5.2 cm.

TWO NEW FLATFISHES FROM THE INDO-AUSTRALIAN ARCHIPELAGO, WITH A SYNOPSIS OF THE SPECIES OF THE GENERA *POECILOPSETTA* AND *NEMATOPS*.

By

J. R. NORMAN.

(British Museum, Nat. Hist.).

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Through the kindness of Dr. J. D. F. HARDENBERG I have recently examined an extensive series of Flatfishes (Heterosomata) preserved in the Laboratorium voor het Onderzoek der Zee, Batavia. These include a number of specimens trawled by the S.S. "Gier", all of which had been previously studied by WEBER and BEAUFORT in connection with their work on the Indo-Australian fishes. In addition, there are a few obtained during Dr. MORTENSEN'S expedition to the Bali Sea, and other examples collected by Dr. HARDENBERG in the fish markets of Java and Sumatra. The collection includes examples of two species apparently new to science, which are described below, and I am greatly indebted to Professor DELSMAN for permission to retain the holotypes of these species for the British Museum. The description of the specimen of *Nematops* has led me to undertake a revision of this genus, and of the allied genus *Poecilopsetta,* the results of which are embodied in this paper in the form of a brief synopsis.

My thanks are due and are gratefully tendered to Dr. HARDENBERG, not only for the opportunity of studying this interesting collection, but also for allowing me to retain a large number of the specimens for the British Museum.

The illustrations for this paper have been prepared by Lt.-Col. W. P. C. TENISON, D.S.O.

1. DESCRIPTIONS OF NEW SPECIES.

Nematops macrochirus (Pleuronectidae).

Depth of body nearly 3 in the length, length of head 4⅓. Snout much shorter than eye, diameter of which is about 2¼ in length of head; eyes almost contiguous, their anterior margins about level; upper eye entering dorsal profile of head; each eye with a short tentacle. Maxillary extending to below anterior margin of eye, length about 3 in that of head; lower jaw not projecting, an inconspicuous knob at the symphysis, length 2¼ in head. Teeth in villiform bands, rather better developed on blind side of jaws. Gill-rakers of moderate length, slender; 10 on lower part of anterior arch. Scales of ocular side ctenoid,

those of blind side cycloid; 68 in lateral line. Lateral line absent on blind side of body. Dorsal 65; commencing a little behind middle of upper eye; longest rays about ½ as long as head. Anal 55. Right pectoral with 7 rays, all more or less branched, length a little greater than that of head; left pectoral very much smaller. Pelvics subequal, that of right side a little in advance and nearer median line than that of left side. Caudal with 18 rays; pointed. Caudal peduncle short, its depth about ½ length of head. Brownish; some small dark spots and streaks on dorsal and anal fins; a dusky blotch on basal part of caudal; right pectoral dusky, with an indistinct darker blotch distally.

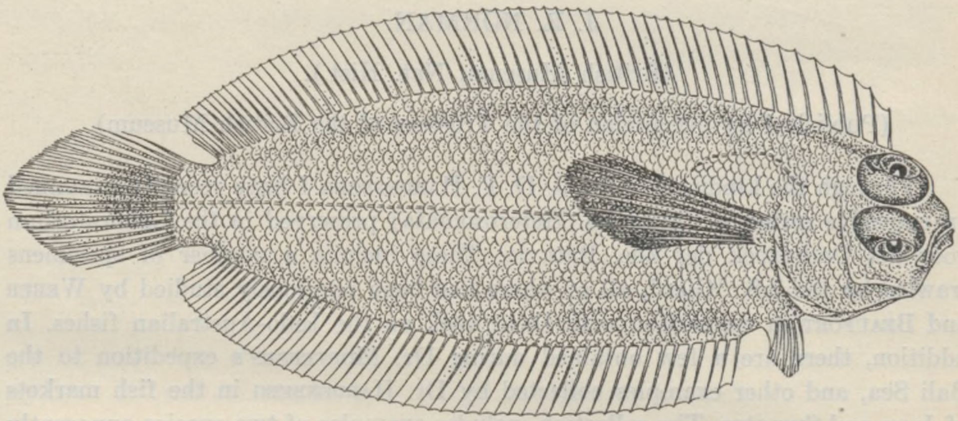

Fig. 1. *Nematops macrochirus.*

Bali Strait (8° 29′ S. 114° 40′ E.), 200 m. Trawl. April 15th, 1929. Coll. MORTENSEN (HARDENBERG).

Described from a single specimen, 106 mm in total length. Holotype — B. M. Reg. No. 1931. 7. 23. 1.

Differing from both the known species in the slender body and large pectoral fin.

Cynoglossus (*Areliscus*) **hardenbergi** (Cynoglossidae).

Depth of body about 3½ in the length (nearly 4 measured on blind side), length of head 4½. Snout obtusely pointed, length about $2^2/_5$ in head; rostral hook of moderate length, its posterior edge $4^1/_3$ in head; extending to a little beyond middle of eye; interorbital width less than diameter of eye, which is 10 in length of head; upper eye in advance of lower; angle of mouth below posterior part of eye, about equidistant from gill-opening and end of snout. A simple nostril between the eyes and a tubular one in front of the lower eye. Dorsal 98. Anal 77. Scales of both sides of body ctenoid; about 80 in a longitudinal series from above gill-opening to base of caudal fin; three lateral lines on ocular side, the upper and middle separated by 16 or 17 series of scales (counted at about middle of fish), the middle and lower by 16; no lateral line on blind side. Yellowish brown, with traces of fine dark longitudinal lines running along the series of scales.

Palembang Fish Market, Sumatra. Coll. HARDENBERG.

Described from a single specimen, 233 mm in total length. Holotype — B. M. Reg. No. 1931. 4. 23.54.

Closely related to *C. feldmanni* (BLEEKER), differing in the larger scales, longer and more pointed rostral hook, etc.

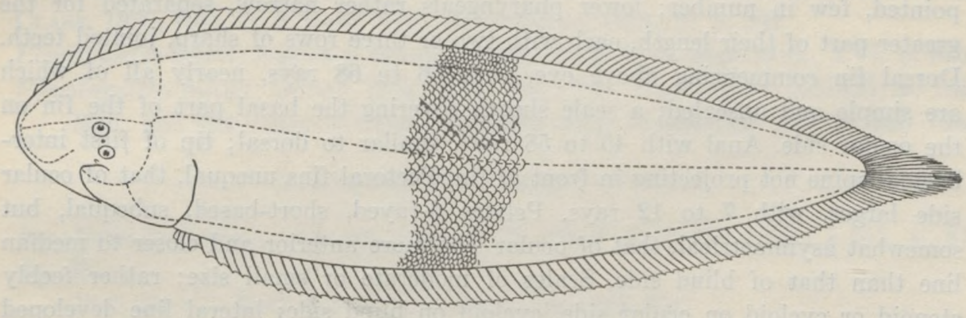

Fig. 2. *Cynoglossus hardenbergi.*

2. SYNOPSIS OF THE GENERA POECILOPSETTA AND NEMATOPS.

The subfamily Pleuronectinae, as defined by REGAN *), includes a large number of genera and species from Arctic and northern seas, with three genera from deep water in the warmer parts of the Atlantic and the Indo-Pacific. These last are all fishes of small size and rather fragile appearance, and may be readily distinguished from their northern relatives by the absence of the lateral line on the blind side of the body. The three genera may be distinguished as follows:—

I. Anterior rays of dorsal and right pelvic more or less prolonged in both sexes, very long in the male; male with strong rostral spines, and with the teeth on ocular side of upper jaw extending on to the outer surface of the jaw. .... **1. Marleyella.** †

II. None of the anterior rays of dorsal or right pelvic prolonged; males similar to females.

A. No orbital tentacles. .... **2. Poecilopsetta.**

B. Each eye with a tentacle. .... **3. Nematops.**

POECILOPSETTA, GÜNTHER.

Poecilopsetta, GÜNTHER, 1880, Shore Fishes 'Challenger', p. 48; HUBBS, 1919, Proc. Biol. Soc. Washington, XXXII, p. 163.

Boopsetta, ALCOCK, 1896, J. Asiat. Soc. Bengal, LXV (2), p. 305; 1899, Cat. Indian Deep-Sea Fish., p. 126.

Alaeops, JORDAN & STARKS, 1904, Bull. U.S.Comm. Fish. Washington, XXII, (1902), p. 623.

Paralimada, BREDER, 1927, Bull. Bingham Ocean. Coll., I (1), p. 86.

† FOWLER, 1926. — Genotype: *Poecilopsetta bicolorata,* VON BONDE.
* REGAN, 1910, Ann. Mag. Nat. Hist., (8) VI, p. 484.

Body ovate or rather elongate, strongly compressed. Eyes on the right side, contiguous or separated by a very narrow space. Mouth rather small, nearly symmetrical, the length of the maxillary $2\frac{2}{3}$ to $3\frac{3}{4}$ in that of head; teeth small, villiform, in one or two rows or in narrow bands in the jaws; better developed on blind side of jaws; palate toothless. Gill-rakers rather short, pointed, few in number; lower pharyngeals rather narrow, separated for the greater part of their length, each with two or three rows of sharp, jointed teeth. Dorsal fin commencing above eye, with 56 to 68 rays, nearly all of which are simple and unscaled; a scale sheath covering the basal part of the fin on the ocular side. Anal with 45 to 58 rays, similar to dorsal; tip of first interhaemal spine not projecting in front of fin. Pectoral fins unequal, that of ocular side larger, with 7 to 12 rays. Pelvics 6-rayed, short-based, subequal, but somewhat asymmetrical, that of ocular side more anterior and closer to median line than that of blind side. Scales of moderate or small size; rather feebly ctenoid or cycloid on ocular side, cycloid on blind side; lateral line developed only on ocular side, extending on to the caudal fin, with a large, flat-topped arch above the pectoral fin; no accessory branches. Vent nearly median in position.

Seven species from deep water in the Atlantic and Indo-Pacific.

Key to the Species.

I. Teeth in one or two rows; length of maxillary less than 3 in that of head *) (Atlantic species).
   A. Scales ctenoid on ocular side; about 80 in lateral line; dorsal 63 to 68; anal 54 to 56. .... **1. beanii.**
   B. Scales cycloid on ocular side; about 63 in lateral line; dorsal 62; anal 53. .... **2. inermis.**

II. Teeth in narrow bands (at least in adults); length of maxillary 3 to $3\frac{3}{4}$ in that of head (Indo-Pacific species).
   A. 90 to 95 scales in the lateral line.
      1. Depth $1^9/_{10}$ to $2^1/_5$ in length; maxillary 3 to $3\frac{1}{2}$ in head; eyes separated by a low narrow ridge.
         a. Dorsal 56 to 61; anal 46 to 50; some of the middle rays of right pectoral branched. .... **3. colorata.**
         b. Dorsal 62 to 67; anal 53 to 58; all the rays or right pectoral simple. .... **4. hawaiiensis.**
      2. Depth $2\frac{2}{3}$ to 3 in length; maxillary $3^3/_5$ to $3^3/_4$ in head; eyes contiguous; dorsal 59 to 65; anal 50 to 54. .... **5. praelonga.**
   B. 60 to 70 scales in lateral line.
      1. Eye about $3\frac{1}{4}$ in head; 60 to 65 scales in lateral line; dorsal 60 to 64; anal 48 to 53. .... **6. plinthus.**
      2. Eye $2\frac{1}{3}$ in head; about 70 scales in lateral line; dorsal 62; anal 54. .... **7. natalensis.**

* Not verified in *P. inermis*.

1. Poecilopsetta beanii (GOODE).

Limanda beanii, GOODE, 1881, Proc. U. S. Nat. Mus., III, (1880), p. 473; JORDAN & GOSS, 1889, Rep. U. S. Com. Fish. Washington, XIV, (1886), p. 288; GOODE & BEAN, 1895, Ocean. Ichth., p. 428, pl. CII figs. 355 a-d; JORDAN & EVERMANN, 1898, Bull. U.S. Nat. Mus., XLVII (3), p. 2646, fig. 932; JORDAN, EVERMANN & CLARK, 1930, Rep. U. S. Com. Fish. Washington, 1928, II, p. 227.
Pleuronectes beani, JORDAN & GILBERT, 1882, Bull. U. S. Nat. Mus., XVI, p. 835.
Poecilopsetta beanii, HUBBS, 1919, Proc. Biol. Soc. Washington, XXXII, p. 163.

Hab. Off the coast of New England; Gulf of Mexico: 111 to 896 fms.

2. Poecilopsetta inermis (BREDER).

Paralimanda inermis, BREDER, 1927, Bull. Bingham Ocean Coll., I (1), p. 87, fig. 36.

Hab. Glover Reef, off British Honduras: 484 fms.

3. Poecilopsetta colorata, GÜNTHER.

Poecilopsetta colorata, GÜNTHER, 1880, Shore Fishes 'Challenger', p. 48, pl. XXII fig. B; NORMAN, 1927, Rec. Ind. Mus., XXIX, p. 41; WEBER & BEAUFORT, 1929, Fish. Indo-Austral. Arch., V, p. 136.
Poecilopsetta maculosa, ALCOCK, 1894, J. Asiat. Soc. Bengal, LXIII (2), p. 130, pl. VII fig. 1; 1895, Illust. Zool. 'Investigator', Fishes, pl. XV fig. 1; 1896, J. Asiat. Soc. Bengal, LXV (2), p. 328.
Boopsetta maculosa, ALCOCK, 1899, Cat. Indian Deep-Sea Fish., p. 127.
? *Boopsetta praelonga,* BRAUER, 1906, 'Valdivia' Tiefsee-Fische, p. 295.
Boopsetta praelonga (*part.*), SEWELL, 1912, Rec. Ind. Mus., VII, p. 10.

Hab. Gulf of Manar; Andaman Sea; Northwest of Sumatra (?).

4. Poecilopsetta hawaiiensis, GILBERT.

Poecilopsetta hawaiiensis, GILBERT, 1905, Bull. U. S. Com. Fish. Washington, XXIII (3), (1903), p. 679, pl. 95; FOWLER, 1928, Mem. B. P. Bishop Mus., X, p. 93.

Hab. Hawaiian Islands: 128 to 238 fms.

I have examined a co-type of this species, which may prove to be identical with *P. colorata.*

5. Poecilopsetta praelonga, ALCOCK.

Poecilopsetta praelonga, ALCOCK, 1894, J. Asiat. Soc. Bengal, LXIII (2), p. 139, pl. VII fig. 2; 1895, Illust. Zool. 'Investigator', Fishes, pl. XV fig. 2; 1896, J. Asiat. Soc. Bengal, LXV (2), p. 328; 1898, Ann. Mag. Nat. Hist., (7) II, p. 156; NORMAN, 1927, Rec. Ind. Mus., XXIX, p. 40, fig. 11.
Boopsetta umbrarum, ALCOCK, 1896, J. Asiat. Soc. Bengal, LXV (2), p. 305; 1897, Illust. Zool. 'Investigator', Fishes, pl. XVII fig. 5.

Boopsetta praelonga, ALCOCK, 1899, Cat. Indian Deep-Sea Fish., p. 126.
Boopsetta praeolonga (part.), SEWELL, 1912, Rec. Ind. Mus., VII, p. 10.
Boopsetta maculosa, WEBER, 1913, 'Siboga'-Exped., Fische, LVII, p. 434.
Poecilopsetta maculosa, WEBER & BEAUFORT, 1929, Fish. Indo-Austral. Arch., V, p. 137, fig. 33.

Hab. Gulf of Manar; Bay of Bengal; Andaman Sea; Ki Islands; Timor Sea.

6. **Poecilopsetta plinthus** (JORDAN & STARKS).

Alaeops plinthus, JORDAN & STARKS, 1904, Bull. U. S. Com. Fish. Washington, XXII, (1902), p. 623, pl. V. fig. 2; 1906, Proc. U. S. Nat. Mus. XXXI, p. 199, fig. 12; FRANZ, 1910, Abh. K. Bayer. Ak. Wiss., Suppl. IV, p. 64; JORDAN, TANAKA & SNYDER, 1913, J. Coll. Sci. Tokyo, XXXIII (1), p. 323, fig. 272.
Poecilopsetta plinthus, HUBBS, 1915, Proc. U. S. Nat. Mus., XLVIII, p. 474.

Hab. Japan.

7. **Poecilopsetta natalensis,** sp.n.

Limanda beanii (*non* GOODE), VON BONDE, 1922, Rep. Fish. Mar. Biol. Surv. S. Afr., 1921, Spec. Rep. I, p. 16; BARNARD, 1925, Ann. S. Afr. Mus., XXI, p. 395.

Hab. Off Natal: 188 fms.

Depth of body $2^3/_5$ in the length, length of head $4^2/_5$. Snout much shorter than eye, diameter of which is $2\frac{1}{3}$ in length of head; eyes almost contiguous, their anterior margins about level; upper eye entering dorsal profile of head. Maxillary extending to a little beyond anterior margin of eye, length about $3\frac{1}{2}$ in that of head; lower jaw $2^3/_5$. Teeth in narrow bands. 11 gill-rakers on lower part of anterior arch. Scales ctenoid on ocular side, cycloid on blind side; about 70 in lateral line. Dorsal 62 (?). Anal 54. Right pectoral with 10 simple rays, length twice in that of head; left pectoral with 5 or 6 rays, smaller. Caudal pointed. Caudal peduncle very short. Greyish brown, with darker patches; dorsal and anal with irregular black markings; a conspicuous black blotch at middle of upper and lower margins of caudal; right pectoral blackish distally.

Described from a single specimen (holotype), 145 mm in total length. B. M. Reg. No. 1922. 3. 27.7.

NEMATOPS, GÜNTHER.

Nematops, GÜNTHER, 1880, Shore Fish. 'Challenger', p. 57.

Very close to *Poecilopsetta,* but each eye with a tentacle.

Three species from deep water in the Indo-Australian Archipelago.

Key to the species.

I. Depth of body $2\frac{1}{3}$ in length; eye $2\frac{2}{3}$ in head; about 66 scales in lateral line; dorsal 67; anal 55. .... **1. microstoma.**

II. Depth of body $2^1/_5$ to $2^2/_5$ in length; eye $2^1/_5$ to $2^3/_{10}$ in head; 44 to 48 scales in lateral line; dorsal 52 to 59; anal 45 to 48. ... **2. grandisquama.**

III. Depth of body nearly 3 in length; eye 2¼ in head; 68 scales in lateral line; dorsal 65; anal 55. .... **3. macrochirus.**

1. Nematops microstoma, GÜNTHER.

Nematops microstoma, GÜNTHER, 1880, Shore Fish. 'Challenger', p. 57, pl. XXIV, fig. c.

Habs. Admiralty Islands: 152 fms.

2. Nematops grandisquama, WEBER & BEAUFORT.

Nematops grandisquama, WEBER & BEAUFORT, 1929, Fish. Indo-Austral. Arch., V, p. 134, fig. 32.

Hab. Bali: 59 to 88 fms.

3. Nematops macrochirus, sp.n.

Hab. Bali Strait: 109 fms.

THE MAMMALS OF JAVA

I. RODENTIA

(Leporidae, Hystricidae, Sciuridae)

By

Dr K. W. DAMMERMAN

(Buitenzorg Museum)

PREFACE.

A new survey of the Java mammals seems to be not a superfluous task. The last work on this group, and not at all an exhaustive one, was that by KONINGSBERGER in 1902, now already nearly thirty years old and therefore out of date. Moreover, this and other publications, even the fundamental works by the older authors, being written in Dutch are often unavailable to many foreign students or misinterpreted by those who have no thorough knowledge of the language. For these reasons a new survey taking into account both the older writings and the newest investigations may be welcome; at the same time it may serve as a basis for future treatises on mammals from other parts of the Indo-Australian Archipelago. As the material of Java mammals in the Buitenzorg Museum is more complete than that from any other part of the region covered by this Institute it seems reasonable to begin with the mammal fauna of this island.

Before giving our descriptions some information about the lines along which the work is carried out may be not out of place here. In distinction to many modern systematic workers I still consider the species as the most important taxonomic unit, the more so as so many of the newly described subspecies are of very doubtful value often based on individual variation only, the subspecific constancy being seldom ascertained. I also prefer to give the synonyma mainly under the species unless the author had a clear notion of the described form being distinct from its nearest allies now considered as subspecies.

As to the names used I followed as strictly as possible the nomenclatural rules but these having not brought us the much desired finality I chose the names used in TROUESSART's Catalogue Supplement 1904 for making the newest nomenclatural novelties understandable for the general reader. These names, so far as they can be considered synonymous, have been printed in heavier type, and I should like to advise all anatomists, physiologists and even those zoologists who are not nomenclatorists by profession to use these names; or always give, at least, these names in addition to the newest ones.

The references are far from complete as only those works or papers dealing with Java mammals or giving Java as a locality where the species occurs have been quoted. For abbreviations and literature see list below.

In using the following paper one should always bear in mind that the keys are only made for the identification of Java species and the description of the species is based on Java material.

In describing the more delicate tinges I followed RIDGWAY's "Color standards and color nomenclature" 1912.

Finally I wish to express my grateful thanks to Mr. C. BODEN KLOSS, Director of Museums Straits Settlements and Federated Malay States, for reading the manuscript. I owe to him the opportunity of examining the collection of Java rodents present in the Raffles Museum, Singapore: this important material has been a great help in accomplishing the work.

LIST OF ABBREVIATIONS OF THE MORE OFTEN QUOTED PERIODICALS.

A.M.N.H. — Annals and Magazine of Natural History, London.
J.A.S.B. — Journal of the Asiatic Society of Bengal.
J.B.N.H.S. — Journal of the Bombay Natural History Society.
J.F.M.S.Mus. — Journal of the Federated Malay States Museums.
J.M.Br.A.S. — Journal of the Malayan Branch of the Royal Asiatic Society (continuation of the J. Straits Br.R.A.S.).
N.L.M. — Notes from the Leyden Museum.
N.T.N.I. — Natuurkundig Tijdschrift voor Nederlandsch-Indië.
P.Z.S. — Proceedings of the Zoological Society of London.
Z.M.L. — Zoologische Mededeelingen van 's Rijks Museum van Natuurlijke Historie te Leiden (continuation of the Notes Leyden Museum).

LIST OF LITERATURE.

Between square brackets the abbreviations by which the more frequently mentioned works are quoted. The works or papers marked with an asterisk are those which deal with the Java fauna generally or Java mammals specially.

v. BALEN [Zoogd.] — De Dierenwereld van Insulinde, I. Zoogdieren, 1914.
* BARTELS, Iets over de fauna in het gebergte-wildhoutbosch van Java, Tectona X, 1917, p. 261.
BLANFORD [Ind. Mamm.] — The Fauna of British India, Mammalia, 1891.
DAMMERMAN [Landb. Dierk.] — Landbouwdierkunde van Oost-Indië, 1919.
——— [Agric. Zool.] — The Agricultural Zoology of the Malay Archipelago, 1929.
* ——— [Tjibodas] — The fauna of the Nature Reserve Tjibodas-Gn.Gede, Excursion C 3, 4th Pac. Sci. Congr., 1929 (list of mammals, p. 21).
* ——— On the Zoogeography of Java, Treubia XI, 1929, p. 1 (list of mammals, p. 33).
* v. HEURN (F. C.), Het land Bolang en zijn natuurlijke rijkdommen, Ind. Gids 49 II, 1927 (Zoogdieren, p. 704).

* HORSFIELD [Zool. Res.] — Zoological researches in Java, and the neighbouring islands, London 1824.

JENTINK [Cat. ost.] — Catalogue ostéologique des Mammifères, Mus. d'Hist. naturelle des Pays-Bas, T. IX, 1887.

——— [Cat. syst.] — Catalogue systématique des Mammifères, idem T. XI, 1892; T. XII, 1888.

* JUNGHUHN, Java, zijne gedaante, zijn plantentooi en inwendige bouw, 2e Dr. I-III, 1853—1854.

KLOSS, Seven new Malaysian Mammals, Journ. F.M.S.Mus. X, 1921, p. 229.

* KOHLBRUGGE, Zoogdieren van den Tengger, Natuurk. Tijdschr. Ned. Ind. 55, 1896, p. 261.

* KONINGSBERGER, De Zoogdieren van Java, Med. 's Lands Plantent. Buitenzorg 54, 1902.

* ——— Zoologische wandelingen te Tjibodas I-VI, Teysmannia 18, 1907.

* ——— Java, Zoologisch en Biologisch, Buitenzorg 1915.

v. MARTENS [Preuss. Exp.] — Die Preussische Expedition nach Ost-Asien, Zool. I, 1876.

* MARTIN [Java] — Unsere Palaeozoologische Kenntnis von Java, Leiden 1919.

MOHNIKE [Thierl. Mal.] — Blicke auf das Pflanzen- u. Thierleben in den Niederl. Malaienländern, 1883.

MÜLLER en SCHLEGEL [Verh. Zoogd.] — Temminck's Verhandelingen over de Natuurl. Geschiedenis der Ned. overzeesche bezittingen — Zoogdieren, 1839—1844.

* RAFFLES [Java] — The History of Java, 2nd Ed., 1830.

* ROBINSON and KLOSS, On five new mammals from Java, Ann. Mag. Nat. Hist. (9) IV, 1919, p. 374.

* SODY, Lijst van Buitenzorg-vogels en zoogdieren, Natuurk. Tijdschr. Ned. Ind. 87, 1927, p. 181.

* ——— Naamlijst van de Zoogdieren van Java. Met korte beschrijving van twee nieuwe subspecies, Natuurk. Tijdschr. Ned. Ind. 89, 1929, p. 160.

* ——— Twee Zoogdierlijsten van Java, Natuurk. Tijdschr. Ned. Ind. 90, 1930, p. 274.

TEMMINCK [Mon. Mamm.] — Monographies de Mammalogie, I 1827, II 1835—1841.

——— [Fauna Jap. Intr.] — Coup-d'oeil sur la faune des îles de la Sonde et de l'empire du Japon, Faune du Japon, Introduction, 1835.

——— [Inde Arch.] — Coup-d'oeil général sur les possessions néerlandaises dans l'Inde Archipélagique I-III, 1846—1849.

* THOMAS and WROUGHTON, On a collection of mammals from Western Java, Proc. Zool. Soc. London 1909, p. 371.

TJEENK WILLINK, Mammalia voorkomende in Nederlandsch-Indië, Natuurk. Tijdschr. Ned. Indië 65, 1905, p. 153.

TROUESSART [Cat.] — Catalogus Mammalium tam viventium quam fossilium, 1897—1899.

TROUESSART [Cat. Suppl.] — idem, Quinquennale Supplementum, 1904—1905.
* VETH, Java, geographisch, ethnologisch, historisch, 2e Dr. Dl. III, 1912.
WEBER [Zool. Erg.] — Zoologische Ergebnisse einer Reise in Niederländisch Ost-Indien I-IV, 1890—1907.

Order **RODENTIA**

(RODENTS — KNAAGDIEREN)

THOMAS, On the Genera of Rodents, P.Z.S. 1896, p. 1012. MILLER and GIDLEY, Synopsis of the supergeneric groups of Rodents, Journ. Wash. Acad. Sci. VIII, 1918, p. 431. WHROUGHTON, Indian Mammal Survey—Rodentia, J.B.N.H.S. 26, 1919, pp. 351, 776, 954; 27, 1920, p. 57.

Key to the suborders

1a. Four upper incisors, a smaller inner pair behind the outer ones .... Duplicidentata
1b. Two upper incisors .... Simplicidentata

Suborder DUPLICIDENTATA

Only one family represented in Java .... Leporidae

Suborder SIMPLICIDENTATA

Key to the families

1a. Processus angularis of mandible arising from outer side of alveoli. Body covered with spines .... Hystricidae
1b. Processus angularis arising from lower edge of alveoli 2
2a. One or two upper premolars and one lower one on each side; processus postorbitalis present; tibia and fibula distinct. Tail bushy .... Sciuridae
2b. No premolars present, upper and lower molar series with three teeth; processus postorbitalis absent; tibia and fibula united. Tail largely scaly Muridae

Suborder ***DUPLICIDENTATA***

Fam. LEPORIDAE

(HARES — HAZEN)

FORSYTH MAJOR, On fossil and recent Lagomorpha, Trans. Linn. Soc. London (2) Zool. VII, 1899, p. 433. LYON, Classification of the hares and their allies, Smithson. Misc. Coll. 45, 1904, p. 321. POCOCK, The external characters of the Lagomorph Rodents, P.Z.S. 1925, p. 669.

Genus **LEPUS,** LINNAEUS (1758).

The only genus represented in Java, with one species.

Lepus nigricollis F. CUV.

(The Black-naped Hare — De Javaansche Haas)

Lepus nigricollis

F. CUVIER, Dict. Sci. Nat. 26, 1823, p. 307. MÜLLER, Verh. Zoogd., 1839, p. 37. ZELEBOR, Reise Novara Zool. I, 1869, p. 31. MARTENS, Preuss. Exp. I, 1876, pp. 256, 348, MOHNIKE, Thierl. Mal. 1883, p. 429. JENTINK, Cat. ost. 1887, p. 237; Cat. syst. XII, 1888, p. 112; Tijdschr. Aardr. Gen. (2) VI, 1889, p. 245; Weber's Zool. Erg. I, 1890, p. 122. WEBER, op.c. p. 95, BLANFORD, Ind. Mamm. 1891, p. 449, fig. 147. TROUESSART, Cat. 1897, p. 652. KONINGSBERGER, Med. Plantent. 54, 1902, p. 57. TROUESSART, Cat. Suppl. 1904, p. 543. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 268. VETH, Java III, 1912, p. 292. v. BALEN, Zoogd. 1914, p. 256. BREHM, Tierl. Säuget, II, 1914, p. 123. KONINGSBERGER, Java, 1915, p. 311. OLIVIER, Teysmannia 27, 1916, p. 484. ENCYCL. Ned. Indië II, 1918, p. 75. SODY, N.T.N.I. 87, 1927, p. 199; 89, 1929, p. 162. DAMMERMAN, Treubia XI, 1929, pp. 5, 6, 35.

Lepus melanauchen

TEMMINCK, Faune Jap. Intr. 1835, p. XIII.

Lepus melanonauchen

TEMMINCK, Inde Arch. I, 1846, p. 325.

Lepus kurgosa

GRAY, Voy. Samarang Zool. 1849, p. 23. WALLACE, Geogr. Distr. Anim. I, 1876, p. 350; Island Life 1880, p. 358.

....

v. HEURN, Ind. Gids 49 II, 1927. p. 707.

Vernacular names [1]).

This hare is known in West Java as "kelinchi", a corruption of the Dutch "konijntje" (rabbit).

Nomenclatural.

In 1835 TEMMINCK introduced the new name *L. melanauchen*, corrected in 1846 by the same author into *melanonauchen.* But the species was rightly recognized as the Indian *L. nigricollis* by MÜLLER in his first paper of the "Verhandelingen" (1839).

The name *kurgosa* is not applicable to this Javan hare, it being a synonym of the Indian *L. ruficaudatus.*

Description.

Upperparts yellowish brown, variegated with black, hind part of the rump more greyish. Fur of the back consisting of yellowish brown hairs with darker bases and black tips, the interspersed longer hairs with the third terminal black. Behind the ears on the neck a black or brownish black mark as broad as the head. The head above has the same colour as the back; cheeks and muzzle greyish; above the nares the hairs are more rufous. Above and beneath the eyes, which have light orbital rings, are patches of black hairs. On the front of the head usually a small white spot. Whiskers black or white with black basal end. Ears when turned forward reaching beyond the head; outside dark brown, the tip blackish, the base greyish white; inside greyish, the outer margin bordered by a very narrow white fringe.

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[1]) In transcribing these names according to the Dutch spelling, ch = tj, j = dj, u = oe, and y = j.

Underparts white except for the breast which is orchraceous and the hinder parts of the cheeks which are dark greyish. The sides are demarcated from the white underside by ochraceous hairs. Fur of lower surface composed of pure white hairs.

The short tail is coloured above like the back or rump, but often more uniformly blackish; underneath white.

Forelegs on the outside ochraceous, on the inside of a lighter shade; hindlegs more greyish like hinder part of back, the inside whitish. Paws underneath covered with tufts of strong hairs of clay colour.

Female with 4 abdominal mammae, the hindmost ones much nearer to each other than the anterior ones. The young ones are more rufous on the back, the black patches more regularly dispersed, whereas in older specimens these black hairs form irregular lines and spots. A young individual (♀) from Buitenzorg is more uniformly rufous on head and back, the head especially being without the typical black variegations of the normal examples.

Remarks. We were able to compare our Javanese examples with four Indian specimens, one from Ceylon and three from continental India, kindly lent by the Indian Museum, Calcutta. The latter have the colour of the forelegs more tawny, the muzzle yellowish instead of greyish, cheeks also washed with ochraceous and the front of the head from the nares more tawny. The general colour of the back is less dark and the black variegations are less conspicuous. I do not know whether these deviations are constant, as the Indian examples were old and somewhat faded. But should the Java form prove to be different it should bear the name "*melanauchen*" first used by TEMMINCK in 1835.

Fig. 1. Footprint of *Lepus nigricollis*; right fore and hindpaw; ¾ nat. size.

Footprint (fig. 1).

The footprint of the hare is rather characteristic but indistinct owing to the hairy mat on the underside of the paws. Impression of the forepaw about 2.3 × 4 cm; of the hindpaw, when fully stretched, 2.7 × 6.7 cm. When the animal is hopping the heel does not make a print and the whole impression is much shorter, about 5 cm.

Measurements and weight.

Measurements, average and maximum (in mm): total length, 490 (514); head and body, 415 (444); tail, 71 (79); ear, 85 (90); hindfoot, 93 (94).

Weight of two examples in the Buitenzorg Museum 1450 and 1340 gr, according to OLIVIER (1916) a full-grown specimen may even reach 2500 gr.

Skull.

Part of the maxillary covering the nasal cavity and squamosum in the neighbourhood of the auditory bullae broken up into a bony network; supraoccipital also very spongeous. Two pairs of upper incisors, a smaller pair behind the larger ones; the upper incisors each with one longitudinal groove

Measurements

Mus. Btzg. No.	♂ 117	♀ 1879	♂ 1883	♀ 2373	♂ 2410
total length	485	514	470	495	474
head & body	415	444	400	416	406
tail	70	70	70	79	68
ear	77	90	90	86	84
hindfoot	—	94	93	93	93

filled with cement; p^1 with three lobes in front, p_1 divided into two parts, anterior part with two lobes in front. Crown of molars divided into two parts by median transverse fold; m^3 very small.

Skull measurements

Mus. Btzg. No.	♂ 117	♂ 1883	♂ 2410	♂ 2411	♀ 1879	♀ 2373
total length	83.5	79.9	81.9	85.8	85.7	81.0
basilar length	68.8	63.6	66.3	69.4	69.6	65.3
zygomatic breadth	40.1	38.7	40.4	40.3	41.6	41.7
cranial width	28.5	27.5	28.2	28.1	28.4	27.5
least postorb. breadth	12 7	12.0	14.2	11.8	13.1	13.0
med. length nasals	37.5	36.5	35.3	39.1	39.3	—
gr. breadth comb. nas.	19.3	18.5	21.3	19.5	21.4	18.4
palatilar length	30.6	29.3	29.4	30.4	31.7	29.2
length inc. foram.	21.8	21.0	22.0	21.4	22.1	20.2
length upper mol. ser.	15.7	14.9	14.2	16.0	15.5	14.7
diastema i-p	22.6	22.7	22.0	22.7	22.9	21.4
length lower mol. ser.	17.4	15.2	14.5	17.0	16.9	15.6

Measurements, average and maximum (in mm): total length, 83 (85.8); basilar length, 67 (69.6); zygomatic breadth, 40.5 (41.7); cranial width, 28 (28.5); least postorbital breadth, 13 (14.2); median length of nasals, 37.5 (39.3); greatest breadth of combined nasals, 20 (21.4); palatilar length, 30 (31.7); length incisive foramina, 21.5 (22.1); length upper molar series, 15 (16); diastema i-p, 22.5 (22.9); length lower molar series, 16 (17.4).

Habits.

The species prefers open country with some shrubs for refuge. It is a rather harmless animal but it may become troublesome in vegetable gardens and for other low-growing crops. In West Java it is often found in tea gardens but it does no damage to this crop eating mainly thick-leaved weeds. It makes its appearance at twilight and night, and as a true hare it does not burrow but makes a litter where also the young ones are dropped. There is apparently no special rutting season and the number of young seems always to be two only. The period of gestation is said to be about one month.

Distribution.

India, Ceylon and West Java. In West Java the species occupies a very limited area, KONINGSBERGER (1915) giving its boundaries as follows: West the river Tjikandi in Bantam, East the river Tjitaroem, South the mountain range Salak-Gede. But this hare is now recorded from Rangkasbitoeng (OLIVIER) and Tjibadak. The species is evidently introduced into Java; moreover, the vernacular name mentioned above is also an indication of the correctness of this opinion. VON MARTENS (1876), who could buy living specimens at the Batavia markets, tells us that the species was said to have been introduced by the Governor-General DAENDELS (1807-1811), but there seems to be no historical confirmation for this supposition. VON MARTENS himself cites Major THORN's "History of the conquest of Java, London 1815", but the statement of this author does not sound very reliable as he relates that "hares and rabbits are pretty common, and deer and antilopes also plentiful".

In the Leiden Museum is a skeleton from Buitenzorg originating from KUHL and v. HASSELT, which must have been taken at the time these naturalists were making collections there in 1821.

Localities. West Java: Rangkasbitoeng; Batavia; Depok; Bolang; Buitenzorg; Tjibadak.

Suborder *SIMPLICIDENTATA*

Fam. HYSTRICIDAE

(PORCUPINES — STEKELVARKENS)

LYON, Notes on the Porcupines, Proc. U. S. Nat. Mus. 32, 1907, p. 575. POCOCK, External characters of Hystricomorph Rodents, P.Z.S. 1922, p. 365. LÖNNBERG, On the Chinese Porcupine *Hystrix subcristata* with some remarks on other members of the genus, Ark. Zool. 15, No. 18, 1923, p. 1.

Genus **HYSTRIX**, LINNAEUS (1758).

The only species in Java, *H. javanica*, was made the type of the genus *Acanthion* by F. CUVIER in 1822. This genus differs from the genus *Hystrix* s. str. only cranially in having much smaller nasals, these being not yet $^2/_5$ of the length of the skull, and having no depression on the parietals at the meeting of sagittal and coronal sutures. As pointed out by LÖNNBERG the division is, however, wholly artificial and as, moreover, the species belonging to the two genera are very similar in external appearance, we prefer to drop the genus *Acanthion.*

Hystrix brachyura javanica F. Cuv.

(The Javanese Porcupine — Het Javaansche Stekelvarken).

Acanthion javanicum

F. CUVIER, Mem. Mus. Hist. Nat. Paris IX 1822, pp. 424, 431, pl. I, figs. 3, 4. JUNGHUHN, Java I, 1853, p. 328. GERVAIS, Hist. Nat. Mamm., 1854, p. 332. GRAY,

P.Z.S. 1866, p. 310. JENTINK, Cat. ost. 1887, p. 232; Cat. syst. XII, 1888, p. 103; Weber's Zool. Erg. I, 1890, p. 121. WEBER, op. c. p. 95; III, 1894, p. 267. LYON, Proc. U.S. Nat. Mus. 32, 1907, p. 580. VETH, Java III, 1912, p. 292.

Hystrix torquata
v. D. HOEVEN, Tijdschr. Nat. Gesch. Phys. III B, 1836, p. 110.

Hystrix ecaudata
IDEM, l.c., p. 110.

Hystrix fasciculata
MÜLLER, Verh. Zoogd. 1839, p. 36. MOHNIKE, Thierl. Mal. 1883, p. 429.

Hystrix brevispinosa
WAGNER, Schreber's Säugeth. Suppl. IV, 1844, p. 20.

Hystrix Flemingii
GRAY, P.Z.S. 1847, p. 101.

Hystrix javanica
WATERHOUSE, Nat. Hist. Mamm. II, 1848, p. 465, pl. XX, fig. 4. MARSHALL, P.Z.S. 1871, p. 235. JENTINK, N.L.M. I, 1879, p. 87. KOHLBRUGGE, N.T.N.I. 55, 1896, p. 263. TROUESSART, Cat. 1897, p. 617. KONINGSBERGER, Med. Plantent. 54, 1902, p. 57. TROUESSART, Cat. Suppl. 1904, p. 511. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 266. BREHM, Tierl. Säuget. II, 1914, p. 188. v. BALEN, Zoogd. 1914, p. 261. KONINGSBERGER, Java 1915, p. 224. DAMMERMAN, Landb. Dierk. 1919, p. 219, fig. 94. ENCYCL. Ned. Ind. IV, 1921, p. 110. SODY, N.T.N.I. 87, 1927, p. 199. WEBER, Säuget. II, 1928, p. 289.

Acanthion (Acantherium) javanicum
GRAY, Voy. Samarang Zool. 1849, p. 22.

Hystrix brachyura javanica
DAMMERMAN, Agric. Zool. 1929, p. 275, fig. 130; Treubia XI, 1929, p. 35.

Acanthion brachyurus javanicus
SODY, N.T.N.I. 89, 1929, p. 164; 90, 1930, p. 282.

....
v. HEURN, Ind. Gids 49 II, 1927, p. 706.

Vernacular names.

The porcupine is everywhere denoted by the malay name "landak".

Nomenclatural.

MÜLLER (1839) considered the forms of *Hystrix* from Java, Sumatra and Borneo as one and the same species, mentioned by him under the name *fasciculata* SHAW (1801). Later on most authors referred the true porcupines from the Greater Sunda Islands to different species but lately the forms were again united now being treated as subspecies of the *H. brachyura* originally described from the Malay Peninsula by LINNAEUS (1758).

The names *torquata* and *ecaudata* are both nomina nuda, *torquata* being a synonym of *javanica,* whereas there seems to have been an example in the Leiden Museum labelled "*ecaudata* Boie et Macklot". According to JENTINK (1879) this specimen is no longer to be found.

Description.

Colour above brownish, the lower half of the back bearing long quills. Head with long spinous hairs, brownish with lighter bases and darker towards the tips, growing longer on the nape but not forming a real crest. The brownish black whiskers are very long, the longest ones 15 cm, the tips being sometimes whitish. Behind the eye a few shorter bristles. Ears almost naked, the inside

clad with white hairs. Anterior half of the back covered with strong flat spines, grooved above, with light bases and white tips, these more conspicuous in the spines of the sides; spines on the back up to 6 cm. Beneath the spines very few white hairs are found. The round quills on the lower part of the back can reach a length of 16 cm; the basal half is white, the distal half with a white tip and a dark band which usually is of nearly equal length to the white portion. The hindermost part of the back bears shorter quills. Scattered between the stronger rigid quills there are more slender and flexible ones, being almost entirely white, most of them having a dark ring near the base; they may reach a length of 18 cm.

Under surface lighter brownish, the throat with a collar of white spines and a more or less conspicuous band of the same colour on the breast between the forelegs. The chin almost naked. Middle part of the belly with flat brownish spines.

The short tail is adorned at its end with a number of white hollow open quills stalked on long supports, with which the animal can make a rattling noise. Base of the tail above with quills like those on the back, underneath with white quills and spines.

Fore and hindlegs covered above with long dark brown hairs, underside more sparsely haired; the nails of a light horny colour.

The female has 6 mammae.

Fig. 2. Footprint of *Hystrix javanica*; right fore and hindpaw; ½ nat. size.

Footprint (fig. 2).

The print of the forepaw is about 6.5 × 3.7 cm, that of the hindpaw 9.5 × 4 cm when fully stretched, without the heel only 7.2 cm long.

Measurements and weight.

The largest specimen measured by us has a total length of 773, head and body 686, tail 87, ear 36 mm; and a weight of 8422 grammes.

Skull.

As the series in our collection consists mainly of half-grown individuals we give only the cranial measurements of the largest example.

Total length, 128.6; basilar length, 111.9; zygomatic breadth, 66.8; cranial width, 43.3; least postorbital breadth, 36; median length of nasals, 50.1; greatest breadth of combined nasals, 24; palatilar length, 52.5; length incisive foramen, 4.2; length upper molar series, 25.5; diastema i-p, 33.7; length lower molar series, 29.8 mm.

Habits.

The porcupine is a common animal of the lowlands and hilly regions, feeding on roots, tubers and low-growing crops and becoming often noxious in this way. It lives in pairs hiding itself during day-time in holes or caves or they make burrows in the soil which have usually two exits, one ending just beneath the surface. When pursued they break through this hidden exit with

astonishing rapidity. They come out at twilight and forage during the night. When angry the animal makes a rattling noise with the hollow tail quills at the same time erecting the dorsal spines and trampling the soil with its hindfeet.

The sound emitted is a kind of grunting. It keeps its fiends at a distance by turning upon them the large quills with which it can inflict severe wounds.

There seem to be only two young at each birth; two nearly full-grown embryo's were found once in a pregnant female from Buitenzorg at the end of September.

The species is much pursued on account of the quills, these being used for hairdresses, ornaments, boxes, and for making needles etc. Chinese people particularly are fond of the flesh which is very palatable.

Distribution.

The subspecies *javanica* is found all over Java and perhaps also in some islands in the neighbourhood but the subspecific affinities of the latter forms have not yet been fully settled.

Fam. SCIURIDAE

(SQUIRRELS — EEKHOORNS)

FORSYTH MAJOR, On the dentition and classification of the Sciurinae, P.Z.S 1893, p. 179. ROBINSON and KLOSS, A nominal list of the Sciuridae of the Oriental Region, Rec. Ind. Mus. XV, 1918, p. 171. POCOCK, External characters of some squirrels, P.Z.S. 1922, p. 1171; The classification of the Sciuridae, P.Z.S. 1923, p. 209.

Key to the Subfamilies

1a. Flying squirrels, limbs united by a membrane. Skull broad with short rostrum; postorbital processes strongly developed. Molars more or less hypselodont .... Pteromyinae

1b. Limbs free. Skull mostly slender and the postorbital processes less expanded. Molars brachyodont .... Sciurinae

Subfamily *PTEROMYINAE*

(FLYING SQUIRRELS — VLIEGENDE EEKHOORNS)

SCHLEGEL en MÜLLER, Vliegende eekhoorns, Verh. Zoogd. 1839—44, p. 103.

Key to the genera

1a. Size large, head and body exceeding 30 cm in length. An interfemoral membrane between the base of the tail and hindlegs. Tail round and bushy. Pattern of molars much complicated .... *Petaurista*

1b. Size small, length of head and body not exceeding 25 cm. Tail entirely free, flat and distichous. Molars with cusps or ridges regularly arranged in transverse or longitudinal direction .... *Sciuropterus*

Genus **PETAURISTA**, PALLAS (1792).

Key to the species

1a. General colour above uniformly chestnut. Parietal crests of the skull slightly constricted behind; nasals ending posteriorly in line with the premaxillae .... *P. petaurista*

1b. Upper surface bicoloured, mahogany red and dark grey. Parietal crests strongly constricted behind; posterior ends of nasals reaching beyond the line connecting the premaxillae .... *P. elegans*

Petaurista petaurista (PALL.).

(The Red Flying squirrel — De Roodbruine Vliegende eekhoorn)

Sciurus petaurista

PALLAS, Misc. Zool. 1766, p. 54.

Sciurus nitidus

DESMAREST, Nouv. Dict. Hist. Nat. XXVII, 1818, p. 403.

Pteromys nitidus

TEMMINCK, Faune Jap. Intr. 1835, p. XII. MÜLLER, Verh. Zoogd. 1839, p. 35. SCHLEGEL en MÜLLER, op. c. 1839—44, pp. 107, 112. GRAY, Voy. Samarang Zool. 1849, p. 23. JUNGHUHN, Java I, 1853, p. 537. ZELEBOR, Reise Novara Zool. I, 1869, p. 25. JENTINK, Cat. ost. 1887, p. 181; Cat. syst. XII, 1888, p. 3; Weber's Zool. Erg. I, 1890, p. 115 WEBER, op. c., p. 95. KOHLBRUGGE, N.T.N.I. 55, 1896, pp. 263, 296. TROUESSART, Cat. 1897, p. 397. KONINGSBERGER, Med. Plantent. 54, 1902, p. 46. TROUESSART, Cat. Suppl. 1904, p. 298. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 230. V. BALEN, Zoogd. 1914, p. 305. BARTELS, Tectona X, 1917, p. 264. ENCYCL. Ned. Ind. I, 1917, p. 653.

Petaurista nitida

THOMAS, A.M.N.H. (8) I, 1908, p. 250. THOMAS and WROUGHTON, P.Z.S. 1909, p. 387.

Petaurista petaurista

ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 172.

Vernacular names.

Sund.: tando; Javan.: walang kopo. The same names, however, are also given to other species of flying squirrels.

Description.

The dense fur above is long and soft, brilliantly chestnut in colour; fur consisting of hairs with basal half dusky, the distal half brown with black tip; undulating woolly hairs very numerous, mixed red-brown and dark greyish. Head above as back, front and cheeks more bay; tip of nose and orbital rings black. Outside of ears red-brown; basal half of inside almost naked, towards the tip with golden red-brown hairs.

Underparts ochraceous salmon, chin with a dark patch.

Parachute a broad expansion between the legs. Forelegs on the outer side with a special dermal extension, reaching far beyond the hands. It is supported by a bony cartilage originating from the outer side of the wrist. An antebrachial membrane (propatagium) from the arm to the side of the neck. Interfemoral

membrane (uropatagium) short, extending from the base of the tail to the heel. Patagium mainly coloured as the body; the propatagium bordered with long brownish black fur.

The long bushy tail usually chestnut above, the base and the tip always blackish; the terminal tuft with black hairs up to 10 cm long. Underneath the colour is of a lighter shade.

Forelegs above as dorsal side, hands blackish; first half of underside coloured as lower surface of body, the distal half brownish black. At the basis of the hand a bundle of stiff black bristles (carpal vibrissae). Hindlegs above as dorsum, the sides with dark brown fur, the black colour extending along the margin of the uropatagium. Feet blackish. Young specimens seem to be much darker; a foetus from Bandjar (C. Java) in our collection has head and back entirely black. The scrotum of the male is also blackish; the female with three pairs of mammae, situated at regular intervals on the middle of the belly.

Measurements and weight.

Measurements, average and maximum (in mm): total length, 907 (978); head & body, 410 (441); tail, 497 (556); ear, 40.5 (42); hindfoot, 76 (80).

A single specimen of 850 mm length weighed 971 grammes.

Measurements

	W. Java		C. Java		E. Java					
Mus. Btzg. No.	♂ 2008	♂ 2666	♂ 2181	♀ 2339	♂ 697	♂ 699	♂ 703	♀ 700	♀ 698	♀ 702
total length	850	902	978	878	897	907	865	953	943	902
head & body	354	392	422	394	432	414	415	441	441	399
tail	496	510	556	484	465	493	450	512	502	503
ear	38	37	42	42	41	39	41	42	40	42
hindfoot	75	77	80	76	72	75	76	80	74	78

Skull measurements

Mus. Btzg. No.	♂ 2008	♂ 2666	♂ 2181	♀ 2339	♂ 697	♂ 699	♂ 703	♀ 700	♀ 698	♀ 702
total length	65.0	71.6	68.7	66.3	68.5	70.4	68.1	69.8	68.8	69.6
basilar length	57.2	64.0	62.5	58.8	60.5	61.6	60.4	63.0	61.9	61.6
zygom. breadth	44.7	48.6	47.3	44.6	47.8	47.0	49.5	48.2	46.5	49.7
cranial width	28.5	31.8	29.0	29.5	29.8	31.2	31.4	30.8	30.5	31.3
least interorb. br.	13.9	17.5	15.4	14.2	15.5	15.6	16.9	16.6	15.0	16.4
outer dist. proc. postorb.	—	37.5	35.6	33.8	37.9	36.3	38.3	—	38.2	37.7
median l. nasals	13.7	20.6	22.6	20.5	20.5	21.6	21.7	22.5	20.2	—
gr. br. comb. nasals	11.9	13.4	13.6	11.6	12.4	12.9	13.1	13.8	13.8	14.2
palatilar length	30.5	33.7	33.9	31.6	32.3	31.6	31.8	33.1	32.3	32.0
length inc. for.	3.5	4.5	4.0	4.0	3.9	3.6	4.1	3.7	3.7	4.1
l. upper mol. ser.	15.6	16.8	16.5	16.4	15.4	16.7	17.1	17.5	16.5	17.3
diastema i-p	14.0	15.0	15.8	14.1	15.7	14.3	14.3	14.8	15.6	14.4
lower mol. ser.	16.6	17.4	17.2	16.8	17.0	17.8	17.9	17.4	17.8	17.8

Skull (fig. 3).

Skull broad and stout, zygomatic breadth 77.5% of the basilar length; nasals broad and short, ending posteriorly in line with the premaxillae; the parietal crests slightly constricted behind; incisive foramina short.

Measurements, average and maximum (in mm): total length, 68.7 (71.6); basilar length, 61 (64); zygomatic breadth, 47 (49.7); cranial width, 30 (31.8); least

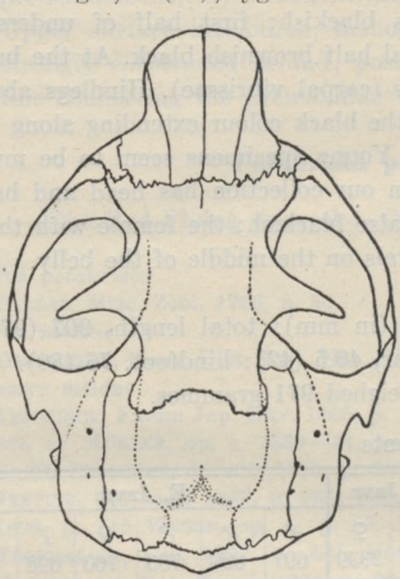

Fig. 3. Skull of *Petaurista petaurista*; nat. size.

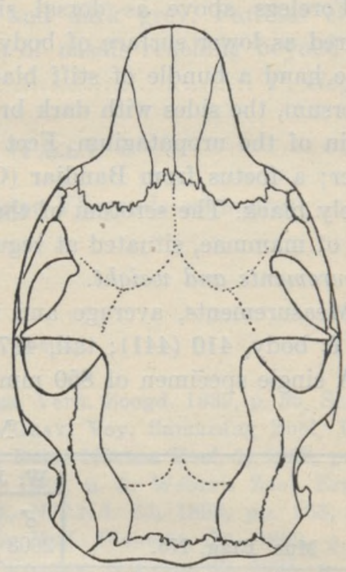

Fig. 4. Skull of *Ratufa bicolor*; nat. size.

interorbital breadth, 15.7 (17.5); outer distance of postorbital processes, 37 (38.3); median length of nasals, 20.5 (22.6); greatest breadth combined nasals, 13 (14.2); palatilar length, 32 (33.9); length of incisive foramen, 3.9 (4.5); length upper molar series, 16.5 (17.5); diastema i-p, 14.8 (15.8); length lower molar series, 17 (17.9).

Penis bone (fig. 5).

Fig. 5. Penis bone of *P. petaurista*, side view; × 2.

The os penis or baculum of *P. petaurista* is a simple bone, the basal half being rounded and hollow, the distal end being expanded and peculiarly twisted; the posterior border of the apex with a very minute tooth. Length 24—25.5 mm.

Habits.

This large flying squirrel is a forest-dwelling animal found from about sea-level to 2000 m altitude. It is quite nocturnal, coming out at twilight; in daytime it sleeps in high trees, often taking refuge in holes; when sleeping it has its back strongly bent concealing the head between the legs. When gliding from one tree to another with expanded membrane and the tail held straight out it can cover a large distance. The food consists mainly of fruits of wild trees, according to SCHLEGEL and MÜLLER preferably those of fig trees.

Distribution.

From Siam throughout the Malay Peninsula to the Greater Sunda Islands [1]).

Subspecific characters.

The Java forms have been divided into two subspecies, the typical *petaurista* and *nigricaudatus*. The latter, from East Java, is mainly characterised by the tail being black above, and the richer chestnut colour of the upper surface. This richer colour, however, is also found in examples from Cheribon and from Pekalongan (C. Java), which have a red-brown tail as in the typical West-Java form.

Key to the subspecies

1a. Tail above partly chestnut (W. Java) .... *P. p. petaurista.*
1b. Tail above entirely brownish black (E. Java) .... *P. p. nigricaudatus.*

Petaurista petaurista petaurista (PALL.)

Petaurista nitida nitida

THOMAS, A.M.N.H. (8) I, 1908, p. 251.

Petaurista petaurista petaurista

ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 172. DAMMERMAN, Tjibodas 1929, pp. 11, 22; Treubia XI, 1929, p. 35. SODY, N.T.N.I. 89, 1929, p. 163.

Description.

Colour of upper surface chestnut maroon or rufous chestnut, rump and thighs darker. Black orbital rings less conspicuous. Tail more or less red-brown above with the terminal tip black.

Distribution.

W. Java: Gobang near Buitenzorg; Tjibodas, 1500 m.; Tjiwangi; Mt. Tjiremai, 700—800 m; Bandjar. C. Java: Pekalongan, 200 m.

Petaurista petaurista nigricaudatus ROB. & KLOSS.

Petaurista petaurista nigricaudatus

ROBINSON and KLOSS, J.F.M.S. Mus. VII, 1918, p. 223; Rec. Ind. Mus. XV, 1918, p. 172. DAMMERMAN, Treubia XI, 1929, p. 35. SODY, N.T.N.I. 89, 1929, p. 163.

Description.

Colour above duller and less brownish than in the typical *petaurista*. Black orbital rings more pronounced. Tail brownish black above, beneath this colour mixed with maroon.

Distribution.

This race is only known at present from the Idjen mountains in the extreme east of Java, where it has been found from 950—1850 m. altitude.

[1]) By the "Greater Sunda Islands" Borneo, Sumatra, Java and surrounding islands are meant.

Petaurista elegans (TEMM.)

(The Bicoloured Flying squirrel — De Tweekleurige Vliegende eekhoorn)

Pteromys elegans

TEMMINCK, Faune Jap. Intr. 1835, p. XII. MÜLLER, Verh. Zoogd. 1839, pp. 35, 56. SCHLEGEL en MÜLLER, op. c. 1839—44, pp. 107, 112, pl. 16, figs. 1—3. TEMMINCK, Inde Arch. I, 1846, p. 333. GRAY, Voy. Samarang Zool. 1849, p. 23. pl. VI. JUNGHUHN, Java I, 1853, p. 365. JENTINK, Cat. ost. 1887, p. 182; Cat. syst. XII, 1888, p. 4. TROUESSART, Cat. 1897, p. 399; Suppl. 1904, p. 298. KONINGSBERGER, Med. Plantent. 54, 1902, p. 46. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 230. v. BALEN, Zoogd. 1914, p. 308. ENCYCL. Ned. Ind. I, 1917, p. 653.

Sciuropterus elegans

MOHNIKE, Thierl. Mal. 1883, p. 428.

Petaurista elegans

ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 177. DAMMERMAN, Treubia XI, 1929, pp. 4, 35. SODY, N.T.N.I. 89, 1929, p. 163.

....

VOSMAER, Nat. Beschr. zelds. gedierten, 1804, pl.

Historical.

VOSMAER (1804) without mentioning a latin name has given a good description and figure of this flying squirrel, but held this species to be the male of *P. petaurista*.

Description.

Upperparts dark grey variegated with white, the parachute and hinder back mahogany red. On dorsum the long straight hairs are entirely black, woolly undulating hairs dark grey intermingled with white hairs, these longer and more numerous in the white patches. The long hairs of the patagium have the basal half dusky, the distal half red-brown with darker tips; woolly hairs dark grey with lighter bases and brown terminal ends. Crown of head as back, front and cheeks chestnut mixed with white and black hairs; muzzle whitish. Orbital rings and long whiskers black. Exterior of ears reddish brown.

The colour of the lower surface is orange rufous, the border of the membrane much darker, burnt sienna. Hands and feet mahogany red above, the feet sometimes more or less clouded with black, especially in young individuals. Tail black above, at the basis more brownish.

Young specimens have the upperparts more brownish and less whitish. Female with 6 mammae situated as in *P. petaurista*.

Measurements.

Measurements, average and maximum (in mm): total length, 684 (713); head & body, 336 (349); tail, 348 (375); ear, 36 (37); hindfoot, 62 (63).

Skull.

The skull is essentially the same as in the fore-going species, but relatively broader, zygomatic breadth 80% of the basilar length; nasals longer and less broad, reaching posteriorly beyond the line connecting the premaxillar bones; incisive foramina larger; the longitudinal parietal crests strongly constricted behind.

Measurements

Mus. Btzg. No.	♂ 2669	♂ 2673	♂ 2674	♀ 2670	♀ 2672
total length	665	681	685	713	677
head & body	320	331	349	338	341
tail	345	350	336	375	336
ear	37	34	35	37	36
hindfoot	62	62	61	62	63

Measurements, average and maximum (in mm): total length, 58.5 (59.4); basilar length, 51.5 (53); zygomatic breadth, 41.5 (42.4); cranial width, 28.3 (28.9); least interorbital breadth, 13 (13.5); outer distance of the postorbital processes, 31.5 (33); median length of nasals, 18.5 (20); greatest breadth combined nasals, 9.9 (10.5); palatilar length, 27.5 (28.3); length incisive foramen, 4.5 (5.1); length upper molar series, 13.8 (14.1); diastema i-p, 12.3 (12.8); length lower molar series, 14.5 (15.4).

Skull measurements

Mus. Btzg. No.	♂ 2669	♂ 2673	♂ 2674	♀ 2670	♀ 2672
total length	57.3	59.0	58.0	59.4	58.4
basilar length	50.1	52.0	51.2	53.0	51.8
zygom. breadth	40.6	41.7	41.0	42.4	41.5
cranial width	27.8	28.6	28.9	28.4	28.0
least interorb. br.	13.0	13.2	13.0	13.5	12.8
outer dist. proc. postorb.	30.2	33.0	32.5	30.3	32.1
median l. nasals	17.8	17.6	17.7	20.0	18.9
gr. br. comb. nasals	10.2	9.7	9.7	9.4	10.5
palatilar length	26.7	28.1	26.6	28.3	27.8
length inc. for.	3.8	4.6	4.3	5.1	4.5
l. upper mol. ser.	13.6	13.9	13.6	14.0	14.1
diastema i-p	11.9	12.8	12.2	12.7	12.1
lower mol. ser.	14.0	14.0	14.5	15.4	14.7

Penis bone.

The penis bone has the same general form as that of *P. petaurista* but is much smaller and less slender; basal half more flattened. Length 11—11.6 mm.

Habits.

This animal has probably the same mode of living as the preceding species but inhabits the higher mountain regions, being found up to the summit of the highest mountains in Java, 3000 m.

Distribution.

The species is restricted to Java.

Localities: Mt. Gede, 3000 m; Mt. Tjiremai, 2000 m; Mt. Slamat, 1400 m; Nusa Kambangan (island off the south coast of Central Java), type locality.

Genus **SCIUROPTERUS**, F. CUV. (1825)

THOMAS, The Genera and Subgenera of the Sciuropterus Group, Ann. Mag. Nat. Hist. (8) I, 1908, p. 1.

The old genus *Sciuropterus* has been split up by THOMAS (1908) into a great many new genera and subgenera mainly on account of differences in the dentition. But the presence or absence of an accessory premolar seems hardly of generic importance as the loss of molars may even occur in one and the same species, *e.g. Mus musculus*. In our opinion the generic validity of at least some of his new genera has to be confirmed by further investigations, therefore we prefer for the moment to treat the divisions as subgenera, at least so far as the forms are concerned which come into consideration here.

Key to the subgenera

1a. Upper molar series with four teeth, p^3 absent; molars each with two parallel transverse ridges, the internal longitudinal ridge represented by two separate cusps .... *Iomys*

1b. Five teeth in the upper molar series, p^3 present; the internal longitudinal ridge of the molars rising into a single crest 2

2a. Behind the eye a strong tuft of long bristles; tail woolly throughout. The thick bullae flattened and opaque; transverse upper molar ridges more or less divided into separate cusps .... *Petinomys*

2b. No series of bristles behind the eye; tail flat and distichous. Bullae well inflated; transverse upper molar ridges clearly defined .... *Hylopetes*

Subgenus ***IOMYS***, THOMAS (1908)

To this section belongs:

Sciuropterus (*Iomys*) **horsfieldi** (WATERH.)

(Horsfield's Flying squirrel — Horsfield's Vliegende eekhoorn)

Pteromys (*Sciuropterus*) *horsfieldi*
WATERHOUSE, P.Z.S. 1837, p. 87.

Sciuropterus horsfieldi
GRAY, Voy. Samarang Zool. 1849, p. 23. THOMAS, P. Z. S. 1886, p. 75. JENTINK, Cat. syst. XII, 1888, p. 6.

Sciuropterus sagitta horsfieldi
TROUESSART, Cat. 1897, p. 400; Cat. Suppl. 1904, p. 299.

Iomys horsfieldi
THOMAS, A.M.N.H. (8) I, 1908, p. 2.

Iomys horsfieldi horsfieldi
ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 178. DAMMERMAN, Treubia XI, 1929, p. 35. SODY, N.T.N.I. 89, 1929, p. 163.

Nomenclatural.

Untill recently this species has always been confounded with *S. sagitta*. In 1886 THOMAS wrote "*S. sagitta* seems to me to be unquestionably the species

commonly known as *S. horsfieldi*", and subsequent authors have followed him. Later on the species was not only recognized as a valid one but was even made the type of a special genus erected for it by the above-mentioned specialist in 1908.

Description.

As we have never seen a specimen of Horsfield's Flying squirrel we can only reproduce here WATERHOUSE's original description running as follows:

"*Pteromys (Sciuropterus) Horsfieldii.* Pter. fuscus, pilis flavescenti-fuscis crebre intersparsis: corpore subtus flavescenti-albo, genis et patagio lumbari ad marginem rufescenti-flavis; cauda subtus nitide ferruginea; auribus mediocribus.

	unc.	lin.
Longitudo ab apice rostri ad caudae basin	9	6
——— auris	0	7½
——— tarsi digitorumque	1	5

Obs. This species is of a larger size than the *Pteromys sagitta,* from which it differs in having the ears larger in proportion; the tail more bushy and of an uniform bright rust colour beneath; the margin of the flank skin is of a reddish yellow colour, as are also the sides of the face below the eye. On the upper parts of the body the fur is of a deep brown; each hair being grey at the base; the interspersed longer hairs, which are abundant, are of a bright brown or reddish-yellow colour at the apex. The general tint produced by this mixture is rufous brown. On the under parts of the body the hairs are of a yellow or yellowish white colour, and not grey at the base.

The specimen from which the above description is taken was presented to the Zoological Society by the Earl of Derby, and is either from Java or Sumatra. I have taken the liberty of naming it after the author of the 'Zoological Researches in Java'."

Distribution.

As stated above the type specimen came either from Sumatra or Java but as far as I am aware the species has never been recorded again from the latter island. JENTINK (1888) mentioned a female *Sciuropterus* under this name collected in Java by KUHL and v. HASSELT, but by adding the synonym "*Sc. aurantiacus*", which does not belong at all to the subgenus *Iomys* but to *Hylopetes,* his identification seems rather questionable. So about the occurrence of *S. horsfieldi* in Java we feel still doubtful.

Subgenus ***HYLOPETES,*** THOMAS (1908)

Only one representative is found in Java:

Sciuropterus (*Hylopetes*) ***sagitta sagitta*** (L.)

(The Arrow-tailed Flying squirrel — Het Vliegende Pijlstaart-eekhoorntje)

Sciurus sagitta

LINNAEUS, Syst. Nat. ed. XII, 1766, p. 88.

Pteromys lepidus
HORSFIELD, Zool. Res. 1824, s.p., pl.
Pteromys sagitta
MÜLLER, Verh. Zoogd. 1839, p. 35. JUNGHUHN, Java I, 1853, p. 244.
Pteromys (Sciuropterus) sagitta
SCHLEGEL en MÜLLER, Verh. Zoogd. 1839—44, pp. 109, 113.
Sciuropterus sagitta
GRAY, Voy. Samarang Zool. 1849, p. 23. JENTINK, Cat. ost. 1887, p. 182; Cat. syst. XII, 1888, p. 6. BLANFORD, Ind. Mamm. 1891, p. 367. TROUESSART, Cat. 1897, p. 400; Suppl. 1904, p. 299. KONINGSBERGER, Med. Plantent. 54, 1902, p. 47. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 232, v. BALEN, Zoogd. 1914, p. 310. BREHM, Tierl. Säuget. II, 1914, p. 567. KONINGSBERGER, Java 1915, pp. 33, 201. BARTELS, Tectona X, 1917, p. 264. ENCYCL. Ned. Ind. I, 1917, p. 653. DAMMERMAN, Landb. Dierk. 1919, p. 221, fig. 95; Agric. Zool. 1929, p. 277, fig. 132.
Sciuropterus lepidus
CAT. Mamm. E. I. Comp. 1851, p. 163. TROUESSART, Cat. 1897, p. 401; Suppl. 1904, p. 300. KONINGSBERGER, Med. Plantent. 54, 1902, p. 47. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 232. v. BALEN, Zoogd. 1914, p. 312. KONINGSBERGER, Java 1915, p. 201.
Sciuropterus (Hylopetes) sagitta
THOMAS and WROUGHTON, P. Z. S. 1909, p. 387.
Hylopetes sagitta (?)
ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 182.
Hylopetes lepidus (?)
ROBINSON and KLOSS, l.c., p. 182.
Sciuropterus sagitta sagitta
DAMMERMAN, Treubia XI, 1929, pp. 4, 35.
Hylopetes sagitta sagitta
SODY, N.T.N.I. 89, 1929, p. 163.

Vernacular names.

Sund.: mọn-mon or enchang-enchang; Javan.: kechubuk or kendo.

Nomenclatural.

LINNAEUS' *Sciurus sagitta* has been identified by THOMAS and WROUGHTON (1909) as the same species as *S. lepidus* HORSF., although the statement in the original description that there is a membrane extending from the head to the wrist does not apply to the members of the genus *Sciuropterus*. This erroneous statement also caused HORSFIELD to consider his *lepidus* a new species. Moreover, his description is based on a rather young, darker, example. For the amalgamation of this species with *S. horsfieldi* see p. 446.

Description.

The general colour of the upper fur is greyish brown, the hairs being black with a narrow yellow-brown ring near the end, the tip black again; the woolly hairs are dark grey. Cheeks and the region beneath the ear greyish; orbital ring black. The long whiskers entirely black. Ears dark, sparsely clad with short brown hairs.

Patagium above blackish, dark grey underneath, fringed with a delicate narrow white border, which is interrupted for a short distance around the angle of the membrane extending from the wrist.

Underparts whitish grey, the long straight hairs white, the woolly hairs grey. Chin, throat and breast more or less white.

The tail has at its base a short constriction for about one cm, being broadest at this end gradually attenuated towards the tip, thus having the shape of a lance-head (hence the specific name). The basal constriction with short woolly hairs only, greyish in colour. The long hairs of the webbed part are fuscous and reach a length of nearly 2 cm. Underneath the colour is of a lighter shade and the proximal half bears a broad light border.

Fore and hindlegs on the outside dark grey, underneath white or whitish grey. Upper surface of hands and feet sparsely clad with dark brown hairs. The male is somewhat darker in colour than the female, upperside more Prout's brown, whereas the female has the back sullied with ochraceous, the yellow rings of the hairs being lighter and broader, and the belly also with an ochraceous hue. Young specimens are less brown above, more dark grey.

Measurements and weight.

Measurements, average and maximum (in mm): total length, 265 (285); head & body, 143 (157); tail, 122 (128); ear, 19 (20); hindfoot, 28.7 (30).

Weight of a male 60, of a female 69 grammes.

Measurements

Mus. Btzg. No.	♂ 964	♂ 967	♂ 1615	♂ 2696	♂ 2698	♀ 975	♀ 1744	♀ 2697	♀ 2699	♀ 2700
total length	266	253	265	251	255	270	260	272	278	285
head & body	139	129	145	139	134	145	140	152	150	157
tail	127	124	120	112	121	125	120	120	128	128
ear............................	20	18	20	18	19	19	18	19	18.5	20
hindfoot	—	—	30	27	29	—	29	27	29	30

Skull.

The first upper premolar is very small, the whole tooth rising into a single cusp, closely applied to the internal front of the second premolar.

Measurements, average and maximum (in mm): total length, 33 (34.2); basilar length, 29 (30.3); zygomatic breadth, 21.7 (23.1); cranial width, 16.6 (17.3); least interorbital breadth, 8 (8.9); outer distance postorbital processus, 15.7 (17.9); median length nasals, 10 (10.5); greatest breadth combined nasals, 5.4 (5.9); palatilar length, 15 (15.8); length incisive foramen, 2.6 (3); length upper molar series, 7.2 (7.6); diastema i-p, 7 (7.3); length lower molar series, 6.9 (7.2).

Habits.

This small flying squirrel is rather common but owing to its nocturnal life is seldom met with. It inhabits the fronds of palm trees chiefly coconut palms, feeding on the young nuts and making its nests among the palm leaves or inside a nut hollowed out by other squirrels.

Skull measurements

Mus. Btzg. No.	♂ 964	♂ 967	♂ 1615	♂ 2696	♂ 2698	♀ 975	♀ 1744	♀ 2697	♀ 2699	♀ 2700
total length	33.5	31.3	33.9	31.4	32.8	34.0	33.2	33.9	33.3	34.2
basilar length	28.6	26.7	29.2	28.6	28.8	30.3	29.0	30.0	29.3	30.3
zygom. breadth	21.8	20.0	21.6	20.3	21.2	23.1	22.1	21.8	22.9	22.8
cranial width	17.0	16.1	16.9	15.8	16.0	17.0	16.7	16.8	17.3	16.7
least interorb. br.	8.9	7.8	8.5	7.5	8.3	8.4	8.0	6.8	8.2	7.8
outer dist. proc. postorb.	15.5	13.5	15.2	—	15.3	17.0	15.2	15.0	17.0	17.9
median l. nasals	10.5	9.6	10.4	9.8	9.2	10.4	9.7	9.8	10.0	10.5
gr. br. comb. nasals	5.1	4.8	5.2	5.4	5.8	5.9	5.3	5.5	5.7	5.4
palatilar length	15.4	14.0	15.2	14.2	14.6	15.2	15.1	15.7	14.8	15.8
length inc. for.	2.3	2.6	2.8	3.0	2.6	2.5	2.6	2.7	2.9	2.6
l. upper mol. ser.	7.6	7.0	7.3	6.9	7.1	7.3	7.2	7.6	7.3	7.3
diastema i-p	7.0	6.7	6.8	6.9	7.0	7.0	7.1	7.1	6.9	7.3
l. lower mol. ser.	7.2	6.7	7.0	6.8	6.7	7.0	6.7	7.0	7.0	6.8

Distribution.

So far as known the typical race is found only in Java.

Localities. W. Java: Buitenzorg; Palaboeanratoe; Soekaboemi; Cheribon; Garoet; Pangandaran; Kalipoetjang. C. Java: Maos. E. Java: Soerabaja.

Subgenus ***PETINOMYS***, THOMAS (1908)

The only Java species and subspecies belonging to this section is:

Sciuropterus (*Petinomys*) ***genibarbis genibarbis*** (HORSF.)

Pteromys genibarbis

HORSFIELD, Zool. Res. 1824, s.p., pl. SCHLEGEL en MÜLLER, Verh. Zoogd. 1839-44, p. 110.

Sciuropterus genibarbis

GRAY, Voy. Samarang Zool. 1849, p. 23. CAT. Mamm. Mus. E. I. Comp. 1851, p. 163. TROUESSART, Cat. 1897, p. 401; Suppl. 1904, p. 300. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 234. THOMAS, A. M. N. H. (8) II, 1908, p. 303. KONINGSBERGER, Java 1915, p. 201.

Sciuropterus (Petinomys) genibarbis

THOMAS, A. M. N. H. (8) I, 1908, p. 6.

Petinomys genibarbis genibarbis

ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 183. SODY, N.T.N.I. 89, 1929, p. 163.

Sciuropterus genibarbis genibarbis

DAMMERMAN, Treubia XI, 1929, p. 35.

Description.

Upper fur very dense, long and soft, russet in colour; dorsal hairs almost entirely consisting of woolly hairs. These are dark gray with yellow-brown terminal ends and small black tips, mixed with a few longer straight hairs of the same colouration. On anterior part of back intermingled long black and greyish hairs. Head above and cheeks greyish, orbital rings russet. Ears very

short almost hidden by the long fur; behind the ear a tuft of white hairs. From the base of the ear arise a bundle of long hairs. The long whiskers on the muzzle and the series of bristles behind the eye (from which the specific name has been derived) entirely black. Upper surface of parachute sooty-brown with a very narrow fringe of lighter fur, the brachial extension bordered by russet hairs.

Underparts greyish white washed with russet, membrane more ochraceous tawny.

Tail very bushy and woolly, broadest at its base, flattened horizontally and with blunt extremity. Colour above wood-brown; beneath except at the base clouded with brown, the middle part bister.

Forelegs above russet, the hands more greyish; underneath like belly. Hindlegs above like back but darker, feet greyish.

Measurements.

The only example at our disposal is a remade skin from a spirit specimen, which had a total length of 265, head & body 132, and tail 133 mm.

Skull.

The interorbital constriction is much stronger than in *S. sagitta*, 5.3 mm; the postorbital processes are less developed; incisive foramen larger, 3.5 mm; molar series larger, upper one, 7.8; lower one, 8; median length of nasals, 10.4; greatest breadth combined nasals, 4.6; palatilar length, 14; diastema i-p, 6.5 m.

Distribution.

In the Buitenzorg Museum there is only one old example, a female labelled "Java". HORSFIELD obtained the type specimen at Poeger on the south coast of the eastern part of the island. It seems to be a very rare animal.

Subfamily *SCIURINAE*
(SQUIRRELS — EEKHOORNS)

HORSFIELD, General enumeration of Indian Sciuri, Zool. Res. 1824. MÜLLER en SCHLEGEL, Eekhoorns, Verh. Zoogd. 1839—44, p. 85. JENTINK, List of squirrels in the Leyden Museum, N.L.M. V, 1883, p. 91. THOMAS. The penis-bone as a guide to the classification of certain squirrels, A.M.N.H. (8), 1915, p. 383.

Key to the genera

1a. Giant squirrels, head and body over 30 cm. Molar series with four teeth *Ratufa*

1b. Pigmy squirrels, head and body not exceeding 9 cm. Facial part of skull very broad, zygomatic breadth more than 80% of basilar length .... *Nannosciurus*

1c. Medium-sized squirrels 2

2a. Arboreal squirrels; tail about the same length as head and body. Colour of back unicolorous .... *Sciurus*

2b. Ground squirrels; tail much shorter than head and body. Back with dorsal stripes .... *Lariscus*

Genus **RATUFA**, GRAY (1867)

Only one species occurs in Java:

Ratufa bicolor (SPARRM.)

(The Large Malay Squirrel — De Groote Tweekleurige Eekhoorn)

Sciurus bicolor

SPARRMANN, Götheb. Vet. Handl. I, 1778, p. 70. HORSFIELD, Zool. Res. 1824 s.p. pl. SCHINZ, Säugeth. 1831, p. 208. MÜLLER en SCHLEGEL, Verh. Zoogd. 1839-44, pp. 85, 88. JUNGHUHN, Java I, 1853, p. 465. v. MARTENS, Preuss. Exp. I, 1876, p. 52. JENTINK, N. L. M. V, 1883, p. 108; Cat. ost. 1887, p. 186; Cat. syst. XII, 1888, p. 14; Weber's Zool. Erg. I, 1890, p. 115. WEBER, op. c., p. 95. BLANFORD, Ind. Mamm. 1891, p. 373. KOHLBRUGGE, N.T.N.I. 55, 1896, pp. 263, 297. KONINGSBERGER, Med. Plantentuin 54, 1902, p. 49. VETH, Java III, 1912, p. 293. KONINGSBERGER, Java 1915, p. 542. BARTELS, Tectona X, 1917, p. 264.

Sciurus javensis

SCHREBER, Säugeth. 1775-92, p. 781, T. 216. GRAY, Voy. Samarang Zool. 1849, p. 23.

Sciurus (Eosciurus) bicolor

TROUESSART, Cat. 1897, p. 410.

Ratufa bicolor

TROUESSART, Cat. Suppl. 1904, p. 308. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 236. THOMAS and WROUGHTON, P.Z.S. 1909, p. 388. BREHM, Tierl. Säuget. II, 1914, p. 532. v. BALEN, Zoogd. 1914, p. 287. ENCYCL. Ned. Ind. I, 1917, p. 653. ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 187. v. HEURN, Ind. Gids 49 II, 1927, p. 706. WEBER, Säuget. II, 1928, p. 274.

Vernacular names.

This large squirrel is known in Java as "jalarang" or "jaralang".

Description.

Colour above bone-brown to blackish brown, the head above entirely, or from behind the eyes, cinnamon-brown, this paler colour extending between the ears and grading into the colour of the back. Dorsal hairs entirely black, mixed with hairs having ochraceous tawny terminal ends and dark tips; coarse woolly hairs blackish. Specimens with worn pelage show irregular patches of these tawny hairs which may become rather extensive so that this discolouration occupies the greater part of the back. The flanks and the rump, often the whole dorsum, interspersed with black hairs tipped with ivory-white, there being a great variation as to the amount of such hairs. Muzzle brownish black; the long whiskers black; cheeks greyish white; the eyes with black orbital rings. The dark dorsal area behind the ears is sharply defined from the light colour of the underside. Ears rather short, the inside and outside black-haired.

Underparts ochraceous buff, the throat lighter. The longer blackish hairs have the distal half light, the dark woolly hairs which have yellow tips showing through.

Outside of forelimbs black, above the hand a band of light ochraceous hairs; the inside ochraceous buff. A few long bristles implanted at the base of the wrist. Hindlegs on outside coloured like the rump; the feet black, the basal portion often more or less whitish especially on the interior part.

Tail on upper and lower surface buff-yellow, the base being coloured like the rump; the very long hairs have the basal part black.

Female with three pairs of mammae situated at equal distance from each other on the belly in a V-shaped form.

Measurements and weight.

Measurements, average and maximum (in mm): total length, 750 (790); head & body, 350 (364); tail, 409 (468); ear, 25.5 (29); hindfoot, 76 (80).

Weight according to KOHLBRUGGE 1400 grammes.

Measurements

Mus. Btzg. No.	2064	2332	2317	Raffles Mus.								
	Buitenzorg			Tjibodas			Badjoelm.			Tamansari		
	♂	♂	♀	♂	♀	♀	♂	♂	♀	♂	♂	♀
total length	736	780	754	753	788	727	690	760	790	710	760	770
head & body	355	364	369	351	320	319	345	350	345	300	350	350
tail	381	416	385	402	468	408	345	410	445	410	410	420
ear	24	26	25	27	28	29	24	24	25	27	23	24
hindfoot	75	74	66	76	80	77	73	74	77	70	75	75

Skull (fig. 4).

Measurements, average and maximum (in mm): total length, 67 (68.7); basilar length, 61.5 (64.2); zygomatic breadth, 44 (46.2); cranial width, 30 (31); least interorbital breadth, 28 (30.5); least postorbital breadth, 21.5 (22.5); outer distance postorbital processes, 39.5 (41); median length of nasals, 23.6 (25.2); greatest breadth combined nasals, 13.4 (14.5); palatilar length, 26.6 (27.6); length incisive foramen, 6.2 (7.1); length upper molar series, 14 (14.6); diastema i-p, 16 (16.6); length lower molar series, 14.7 (15.5).

Skull measurements

Mus. Btzg. No.	2064	2332	2317	2319	Raffles Mus.							
	Buitenzorg				Tjibodas				E. Java			
	♂	♂	♀	♀	♂	♂	♀	♀	♂	♂	♂	♀
total length	66.6	66.1	68.7	65.5	67.6	67.7	66.5	68.3	66.4	67.3	67.2	67.8
basilar length	60.4	60.8	63.1	60.4	62.2	61.6	61.0	64.2	60.1	60.7	61.1	62.2
zygom. breadth	42.6	43.0	43.1	42.5	45.0	43.9	43.8	46.2	44.5	44.3	43.1	43.3
cranial width	31.0	29.7	30.0	29.3	30.8	30 6	29.5	29.9	30.0	30.4	30.7	28.9
least interorb. br.	26.4	26.5	28.0	26.9	27.9	27.5	27.2	27.7	29.0	30.5	27.5	29.0
least postorb. br.	21.0	21.5	21.0	21.6	21.4	22.3	21.7	19.7	22.5	22.2	21.8	19.9
outer dist. proc. postorb.	39.5	39.4	39.8	38.7	40.5	36.8	39.5	40.0	41.0	38.8	40.1	40.1
median l. nasals	23.7	21.8	24.6	24.7	23.1	23.4	23.9	22.5	25.2	24.4	22.8	22.8
gr. br. comb. nasals	11.7	13.3	13.7	12.9	13.8	14.5	13.6	13.2	13.7	13.7	13.2	14.0
palatilar length	26.0	26.8	27.0	26.7	27.4	27.6	26.8	27.3	26.0	26.3	24.6	26.8
length inc. for.	7.1	6.0	6.9	6.3	5.4	6.0	5.5	5.6	5.9	6.3	6.0	6.3
l. upper mol. ser.	12.8	14.4	14.6	14.2	14.4	14.3	14.4	13.7	13.8	13.6	14.0	13.6
diastema i-p	16.2	16.0	16.4	14.8	16.2	16.6	15.3	16.3	16.0	16.1	15.1	14.9
l. lower mol. ser.	13.9	15.5	14.6	14.3	14 6	15.5	14.6	13.6	15.0	14.9	15.0	14.4

Penis bone (fig. 6).

The baculum is a simple short bone of 9.4—9.9 mm length, slightly upcurved; the basal end is expanded and hollowed; the apex narrowed and flattened horizontally.

Habits.

The Large Malay Squirrel is a forest-dwelling species, living generally in pairs or single; it is rather common in uncultivated regions and diurnal in habit. The nest is said to be composed of twigs and leaves in the top of high trees and the number of each litter is only two. When asleep the animal rolls itself up keeping the head covered by the tail.

Fig. 6. Penis bone of *Ratufa bicolor*, side view; × 3.

Distribution.

The species is recorded from the Greater Sunda Islands (except Borneo) and Bali.

Subspecific characters.

Usually two subspecies occurring in Java are distinguished, the West Java form *bicolor* and the *albiceps* from East Java. The form *major* described by MILLER from Tjibodas on account of the larger size has to be dropped. As may be seen from the figures above there is no essential difference as to size of body and skull between examples from Tjibodas and those from other localities in Java.

The differential characters of the two forms are mainly based on differences in colour. But although the large series of East Java specimens present in the Raffles Museum has the general colour above more bister or cinnamon-brown and in worn pelages the buff parts often very extensive, we have got examples from Buitenzorg and Garoet, West Java, which are hardly distinguishable as to the colour of the upper surface. The only reliable character by which the East Java form can be separated is the amount of yellow on the tail, this being darker especially underneath owing to the much shorter yellow terminal ends of the black hairs.

Key to the subspecies

1a. Tail buff-yellow, the long hairs with large yellow distal ends (W. Java) ...... *R. b. bicolor*

1b. Tail darker, the yellow ends of the hairs for less extensive than the black part (E. Java) .... *R. b. albiceps*

Ratufa bicolor bicolor (SPARRM.)

Ratufa bicolor major

MILLER, Proc. Biol. Soc. Wash. XXIV, 1911, p. 28.

Ratufa bicolor bicolor

ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 187. DAMMERMAN, Tjibodas 1929, p. 22; Treubia XI, 1929, p. 35. SODY, N.T.N.I. 89, 1929, p. 163.

Description.

Tail above and underneath buff-yellow, the very long hairs with large yellow terminal ends, basal parts black. For description of the other parts of the body see above.

Distribution.

Localities. W. Java: Oedjoengkoelon; Oedjoengteboe and Tjiomas, 300 m (Bantam); Wijnkoops Bay; Mt. Salak, 300—1000 m; Bolang; Tjibodas, Mt. Gede 1400—1800 m; Kamodjan (Garoet); Tjibaregbeg (south of Garoet); Tasikmalaja; Kalipoetjang.

Ratufa bicolor albiceps (DESM.)

Sciurus albiceps

DESMAREST, Nouv. Dict. Hist. Nat. X, 1817, p. 105. JENTINK, N. L. M. V, 1883, p. 110; Cat. syst. XII, 1888, p. 16.

Ratufa albiceps

TJEENK WILLINK, N.T.N.I. 65, 1905, p. 237.

Ratufa bicolor baliensis

ROBINSON and KLOSS (not THOMAS), Rec. Ind. Mus. XV, 1918, p. 187.

Ratufa bicolor albiceps

DAMMERMAN, Treubia XI, 1929, p. 35. SODY, N.T.N.I. 89, 1929, p. 163.

Description.

This subspecies differs from the typical *bicolor* by the darker tail, the long black hairs of which have less extensive yellow distal ends.

Distribution.

Localities. E. Java: Mt. Raoeng, 700 m; Idjen Massif, 500—1200 m; Badjoelmati.

Genus **SCIURUS**, LINNAEUS (1758)

In 1915 the old genus *Sciurus* was split up by THOMAS on account of the differences in the structure of the os penis, although there are no essential differences in the skulls and teeth, neither in the external appearances. Thus the Oriental species formerly referred to *Sciurus* were put in the genus *Callosciurus*, already established in 1867 by GRAY, the members of which have compound bacula with a narrow blade attached to the main shaft. We are of opinion, however, that not too much importance should be attached to this bone as a taxonomic character. The os penis of the mammals, entirely enclosed by the tissues of the sexual organ, has certainly in this respect not the same importance as in other groups of animals, *e.g.* the insects with their exoskeletal genital apparature. We therefore prefer to consider *Callosciurus* as a subgenus until the generic validity is confirmed by other anatomical characters.

Subgenus ***CALLOSCIURUS***, GRAY (1867)

Key to the species

1a. A clearly defined pale lateral stripe above a dark one, the latter coloured like the sides of the body; a distinct light orbital ring. Skull more slender,

zygomatic breadth 66% of basilar length. Penis bone upcurved and rather stout .... *S. notatus*

1b. Pale lateral stripe less distinct, dark lateral stripe black; orbital rings less conspicuous. Skull broader, zygomatic breadth 72% of basilar length. Penis bone slender and nearly straight .... *S. nigrovittatus*

Sciurus (*Callosciurus*) notatus BODD.

(The Common Malay Squirrel — De Klappereekhoorn)

Sciurus notatus

BODDAERT, Elench. Anim. I, 1775, p. 119. JENTINK, Weber's Zool. Erg. I, 1890, p. 116. WEBER, op.c., p. 95. KOHLBRUGGE, N.T.N.I. 55, 1896, p. 263. KONINGSBERGER, Med. Plantent. 54, 1902, p. 52. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 240. THOMAS and WROUGHTON, P. Z. S. 1909, p. 388. BREHM, Tierl. Säuget. II, 1914, p. 535. V. BALEN, Zoogd. 1914, p. 293. KONINGSBERGER, Java 1915, pp. 58, 200, 301. ENCYCL. Ned. Ind. I, 1917, p. 653. DAMMERMAN, Landb. Dierk. 1919, p. 220. V. D. MEER MOHR, Trop. Natuur IX, 1920, p. 166. KLOSS, J. F. M. S. Mus. X, 1921, p. 232. V. HEURN (F. C.), Ind. Gids 49 II, 1927, p. 706. DAMMERMAN, Agric. Zool. 1929, p. 276. SODY, N.T.N.I. 90, 1930, p. 283.

Sciurus badjing

KERR, Anim. Kingd. 1792, p. 269. JENTINK, Cat. ost. 1887, p. 192; Cat. syst. XII, 1888, p. 27.

Sciurus plantani

LJUNG, K. Vet. Akad. n. Handl. XXII, 1801, p. 99, t. 1. HORSFIELD, Zool. Res. 1824, s. p., pl. MÜLLER, Verh. Zoogd. 1839, p. 35. GRAY, Voy. Samarang Zool. 1849, p. 24. CAT. Mus. E. I. Comp. 1851, p. 151. JUNGHUHN, Java I, 1853, p. 244. ZELEBOR, Reise Novara Zool. I, 1869, p. 24. JENTINK, N.L.M. V, 1883, p. 133. MOHNIKE, Thierl. Mal. 1883, p. 428. BARTELS, Tectona X, 1917, p. 264. V. HEURN (W. C.), Vakbl. Biol. 7, 1925, p. 17. SODY, N.T.N.I. 87, 1927, p. 200.

Sciurus bilineatus

DESMAREST, Mamm. 1817, p. 336. SCHINZ, Säugeth. 1831, p. 208.

Sciurus (*Heterosciurus*) notatus

TROUESSART, Cat. 1897, p. 415; Suppl. 1904, p. 313.

Callosciurus notatus

THOMAS, A. M. N. H. (8) XV, 1915, p. 385. ROBINSON and KLOSS, Rec. Ind. Mus XV, 1918, p. 221. POCOCK, P. Z. S. 1923, p. 219. SODY, N.T.N.I. 88, 1928, p. 325.

Vernacular names.

This common squirrel is known all over Java by the name "bajing"; in Bantam (W. Java) the name "bu-ut" is used for squirrels generally.

Description.

General colour above a variegated umber; longer hairs on middle of back blackish with two to three yellowish rings; dark woolly hairs with two light similar rings, the basal half black. Head above like back, the muzzle darker; the eyes surrounded by a ring of light-coloured hairs. Ears rather short, inside sparsely clad with hairs coloured like the head. The long whiskers which reach far beyond the ears entirely black.

The colour of the underparts very variable, from pure greyish to ochraceous tawny or light orange-rufous, the axillar and inguinal regions often tinged with these colours. The sides bordered by a pale stripe of yellowish colour extending

from fore to hind limbs; under this stripe runs another darker one of the same colour as the sides. Outside of limbs coloured like back, inside coloured like lower surface; hands and feet grey well contrasted with the colour of the limbs exteriorly.

Tail above at the base like rump, but otherwise of a lighter hue, with irregular black bands, the tip often tinged with red; underneath more tawny olive.

There are six mammae in the female, two inguinal and one pectoral pair.

Varieties.

Pure albino's of *notatus* are sometimes met with, in our collection are examples from Buitenzorg and Mr. Cornelis (Batavia).

Measurements and weight.

Measurements, average and maximum (in mm): total length, 370 (385); head & body, 192 (205); tail, 178 (190); ear, 18 (20); hindfoot, 44 (47).

Weight, average and maximum: ♂♂, 228 (248); ♀♀, 232 (256) grammes.

Measurements

	W. Java					C. Java				E. Java		Madoera	
Mus. Btzg. No.	♂ 712	♂ 719	♂ 2021	♂ 2050	♀ 2020	♂ 2109	♂ 1741	♂ 1623	♀ 2102	♀ 232	♀ 1906	♂ 1626	♂ 1627
total length	353	362	350	376	372	376	355	385	378	378	370	370	360
head & body	199	183	177	202	182	189	196	205	204	192	189	190	200
tail	154	179	173	174	190	187	159	180	174	186	181	180	160
ear	20	17	20	18	18	17	18	—	17	19	18	—	—
hindfoot	45	—	43	42	43	45	—	45	43	—	43	47	45

Skull measurements

Mus. Btzg. No.	712	719	2021	2050	2020	2109	1741	1623	2102	232	1906	1625	1627
total length	50.7	47.0	47.4	46.5	46.4	49.8	47.0	48.9	49.2	46.8	45.5	47.3	46.8
bas. length	45.6	40.8	41.0	41.3	40.4	42.7	41.3	43.6	42.2	—	40.5	41.7	41.8
zyg. breadth	31.4	26.6	28.5	27.2	27.0	27.8	27.9	27.8	28.6	28.1	27.6	27.9	27.7
cran. width	22.2	20.5	21.7	21.2	20.7	22.2	20.5	21.7	22.2	21.8	20.8	21.8	21.0
interorb. br.	17.9	15.5	15.9	15.9	15.6	—	16.2	16.1	16.9	16.4	14.6	16.7	16.2
postorb. br.	16.9	17.0	16.9	16.8	17.1	18.3	16.3	17.1	17.8	17.2	16.1	18.0	17.2
med. l. nas.	16.9	—	15.2	14.5	13.9	14.4	15.1	14.5	15.6	14.6	14.0	15.1	—
gr. br. c. nas.	7.0	—	6.9	6.5	5.8	—	6.1	6.9	6.6	6.9	6.7	6.5	6.7
pal. length	23.2	20.3	20.8	20.6	20.2	22.5	20.8	21.5	22.1	20.8	20.2	21.3	20.9
l. inc. for.	3.1	2.9	2.8	2.5	3.1	3.0	—	3.1	3.1	2.7	2.8	2.9	3.0
upper mol. ser.	9.6	9.0	9.2	9.2	9.3	10.0	9.5	9.2	10.3	8.6	9.1	8.9	9.1
diastema i-p	13.2	11.3	11.8	11.0	11.0	12.0	12.1	12.5	11.6	12.3	11.4	11.8	11.8
lower mol. ser.	9.1	9.3	9.0	9.7	9.0	10.0	10.1	—	9.6	9.1	9.1	8.7	9.0

Skull.

Measurements, average and maximum (in mm): total length, 47.5 (50.7); basilar length, 41.5 (45.6); zygomatic breadth, 27.5 (31.4); cranial width, 21.3

(22.2); least interorbital breadth, 16 (17.9); least postorbital breadth, 17 (18.3); median length of nasals, 14.7 (16.9); greatest breadth combined nasals, 6.5 (7); palatilar length, 21 (23.2); length incisive foramen, 2.9 (3.1); length upper molar series, 9.3 (10.3); diastema i-p, 11.7 (13.2); length lower molar series, 9.3 (10.1).

The skull of No. 712, a single specimen from Prinsen Island (Sunda Straits), is very large reaching in nearly all dimensions maxima except the molar series. The latter fact may be an indication that we are not dealing here with a special large race but with a very old individual only.

Penis bone (fig. 7).

The os penis is, like in all members of this group of squirrels, a compound bone consisting of a shaft with a very sharp-edged smaller bone attached to it. The proximal half of the shaft is thickened, its slender distal half strongly upcurved, the apex with two lateral and one median keel. The accessory bone or blade lying in the distal cavity of the shaft is attached to it with expanded base and about $^1/_4$—$^1/_5$ the length of the entire bone. Length (measured in a straight line) 22—25 mm, breadth of hollow basal end 3—3.2 mm.

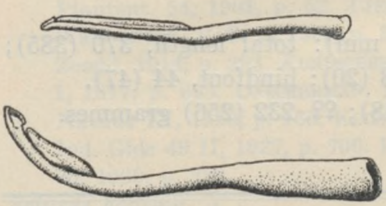

Fig. 7. Penis bone of *S. nigrovittatus* and *S. notatus*, side view; × 2.

Habits.

This is the commonest and most familiar squirrel of the lowlands of Java found abundantly from the seashore up to about 1000 m above sea level. It is everywhere seen in cultivated districts and does not avoid human habitations, being a common sight in gardens and in avenues of trees. It often becomes a notorious pest, specially of coconuts in the husk of which a round hole is eaten to get at the kernel. They are also a nuisance for many kinds of fruits, devouring also the buds and blossoms and stripping off the bark of different trees. The species, however, is not exclusively frugivorous, insects are also eaten.

The cry is a kind of shrill whistling, when alarmed the animal utters a grunting noise. The nest is made in high trees, consisting of a loose structure of twigs and leaves with an inner lining made of fibrous matter, preferably cocos fibres. Usually only two young are produced at each birth; the breeding-season seems to be mainly in the wet monsoon.

Distribution.

Siam, Malay Peninsula, the Greater Sunda Islands, eastward to Bali, Saleyer and probably Celebes.

Subspecific characters.

As already said before the colour of the lower surface of this species is very variable and has led consequently to the description of a number of special races or forms mainly differing in the colour of the fur of the under-parts. In the true *notatus* from West Java the colour of these parts is a uniformly

grey, but in some examples this colour is slightly suffused with ochraceous or tawny, while the axillar and inguinal region, especially in the males, may exhibit an ochraceous tawny or even rufous hue. The eyerings are ochraceous buff. In a single example from Prinsen Id. these orbital rings are light buff, nearly white. As already mentioned before this specimen has a very large skull, the tail being underneath especially light in colour but otherwise it matches the typical *notatus*. Going more eastward and southward we see that the ochraceous suffusion of the under surface becomes more and more intensive. In examples from Garoet and neighbourhood, *vanheurni* SODY, the lower fur, also on the inside of the limbs, has a greyish tinge washed with ochraceuos, the resulting colour being Saccardo's umber. The fur consists of stiff dark hairs with yellow terminal ends and grey woolly hairs with yellowish tips, whereas in true *notatus* the hairs are black and the tips silvery white. But here also the colour is not constant, some specimens are as dark grey as examples from Buitenzorg, others have the tawny suffusion much more intensive and a few are practically not separable from *balstoni* (see below); usually the muzzle is more greyish and the nose more blackish. The forms from Tjilatjap on the south coast of Java have been described as *balstoni,* here the ochraceous tawny colour of the lower surface becomes still richer; the orbital rings are broader and capucine orange, this colour extending on the cheeks. However, a specimen from Buitenzorg has the whole underside washed with ochraceous tawny and in this respect it comes extremely near an example of *balstoni* in our collection except for the eyerings which are smaller and lighter in colour. Specimens from Tjibaregbeg, south of Garoet but west of Tjilatjap, show also various tinges of their underparts; two of them are even more greyish underneath than Garoet examples, but on the whole the series has the rufous colour more intense than in *balstoni,* in other respects they match the latter form but they exhibit a black nose and a more greyish muzzle like the Garoet form.

Now, if we examine series from the north coast of Java we find that they all agree in the more rufous lower fur, which is typical for *madurae,* first described from Madura Id., off the eastern part of Java. In true *madurae* the underside is light orange-rufous or buckthorn brown, the hairs with dark bases but the brighter part far more extensive than in *balstoni,* sometimes the hairs entirely ochraceous to rufous.

Examples from Cheribon (W. Java) have the upperparts like true *madurae* but the eyerings are larger and more orange in colour; sides of head also washed with ochraceous; lower parts like in *madurae* only slightly darker. Specimens from Koedoes (C. Java), named *verbeeki* by SODY, are only less rufous than *madurae,* but according to the author himself there are from the same locality individuals which are indistinguishable from true *madurae*! Still another form, from the Idjen Massif, has been denoted as *tamansari* on account of the slightly more darker lower fur; it differs also from *madurae* in having the upperparts less grey and the shoulders and upper surface of arms a little more sullied with ochraceous. But examples from the Raoeng Mt., also a part of the Idjen Massif,

are hardly different from typical *madurae* in the latter respects. We have got also a small series from the Ijang Mt., west of the Idjen, here again we find examples with the underparts exactly like the true *madurae* and others less rufous, more greyish like *tamansari*.

Thus we see that there are all intergradations between the typical grey-bellied *notatus* from West Java and the rufous-bellied *madurae* from East Java and Madura. This change of colour going from West to East is also in accordance with GLOGER's rule, which states that darker colours inherent to humid rainy areas become more yellowish and red in animals living in dry arid regions. The line of demarcation between the two races runs probably from somewhere west of Cheribon to somewhere east of Tjilatjap. All along this line on either side we can expect intermediate forms. Moreover specimens from arid localities in the western part of Java may show the ochraceous discolouration, whereas those from moist areas in East Java will show a greyish suffusion. We should expect that the forms inhabiting higher mountain regions in the drier eastern half of Java will exhibit a darker lower fur but this seems to be not always the case.

After studying the larger series now at our disposal we can recognize only two truly geographical races in Java, the West-Java *notatus* and the East-Java *madurae*. All other forms are intergradations or only individual variations and in our opinion it is a useless and unnecessary burden to taxonomy to designate and name all these more or less intermediate forms. Moreover, a species like this squirrels inhabiting mainly cultivated districts, which are so diverging as to their environmental conditions, most likely will show all kind of variations, but unless a form can be tied down to a special ecological habitat or a definite climatic area it does not require subspecific separation.

Key to the subspecies

1a. Lower surface greyish or slightly washed with ochraceous (W. Java) .... *S. n. notatus*
1b. Lower surface ochraceous to light orange-rufous with or without a slight greyish suffusion (C. & E. Java, Madura) .... *S. n. madurae*
1c. Intermediate forms with rich ochraceous tawny suffusion of the underparts (W. & C. Java) .... *S. n. notatus* > *madurae*

Sciurus* (*Callosciurus*) *notatus notatus (BODD.)

Sciurus andrewsi
BONHOTE, A. M. N. H. (7) VII, 1901, p. 456. TROUESSART, Cat. Suppl. 1904, p. 313.
Callosciurus notatus notatus
ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 221. SODY, N.T.N.I. 89, 1929, p. 163.
Callosciurus notatus typicus
SODY, N.T.N.I. 88, 1928, p. 326.
Sciurus notatus notatus
DAMMERMAN, Treubia XI, 1929, p. 35.

Description.

General colour above grizzled umber; eyerings ochraceous buff. Ears on the outside blackish. Underparts greyish, the hairs dark with silvery white tips in the typical form; sometimes the tips ochraceous causing a slight suffusion of this colour. Axillae and inguinal region often tinged with tawny or rufous.

Distribution.

West Java. Localities: Prinsen Id.; Oedjoengteboe, 300 m; Tangerang (Bantam); Batavia; Buitenzorg; Wijnkoops Bay.

Sciurus (*Callosciurus*) **n. notatus > madurae**

Sciurus notatus balstoni

ROBINSON and WROUGHTON, J. F. M. S. Mus. IV, 1911, p. 234. DAMMERMAN, Treubia XI, 1929, p. 35.

Callosciurus notatus balstoni

ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 221. SODY, N.T.N.I. 88, 1928, p. 328; 89, 1929, p. 163.

Callosciurus notatus vanheurni

SODY, N.T.N.I. 88, 1928, p. 327; 89, 1929, p. 163.

Description.

Intermediate between *notatus* and *madurae*; greyish colour of lower surface with a strong suffusion of ochraceous tawny; eyerings broader, buffy to orange in colour. Often the muzzle more greyish and the nose more blackish than in typical *notatus*.

Distribution.

South-West and S. Central Java. Localities: Garoet; Tjibaregbeg; Kalipoetjang; Tjilatjap.

Sciurus (*Callosciurus*) **notatus madurae** (THOS.)

Sciurus notatus madurae

THOMAS, A.M.N.H. (8) V, 1910, p. 386. DAMMERMAN, Treubia XI, 1929, p. 35.

Callosciurus notatus madurae

ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 221. SODY, N.T.N.I. 88, 1928, p. 331; 89, 1929, p. 163.

Sciurus notatus tamansari

KLOSS, J.F.M.S. Mus. X, 1921, p. 230. DAMMERMAN, Treubia XI, 1929, p. 35.

Callosciurus notatus tamansari

SODY, N.T.N.I. 88, 1928, p. 329; 89, 1929, p. 163.

Callosciurus notatus verbeeki

SODY, N.T.N.I. 88, 1928, p. 330; 89, 1929, p. 163.

Description.

Colour above less bright than in *notatus*, more light brownish olive; eyerings buffy to orange; sides of head, inside of ears and neck behind them washed with buff. Outside of ears coloured like back in typical *madurae* but in examples from more western localities blackish as in *notatus*. Under surface and inside of limbs ochraceous tawny to orange-rufous, the hairs with dark bases but the brighter part more extensive, or entirely ochraceous to rufous. Specimens from moist localities or humid mountain regions may exhibit a greyish suffusion of

the underparts; if this character proves to be a constant one these forms may be separated as *tamansari*.

Distribution.

North & East Java and Madura. Localities. W. Java: Cheribon; Mt. Tjiremai, 700 m. C. Java: Koedoes. E. Java: Bodjonegoro; Besoeki; Ijang Mt., 500—700 m; Raoeng Mt., 700 m; Idjen Massif, 500 m; Badjoelmati. Madura: Bangkalan; Pamekasan; Soemenep.

Sciurus (*Callosciurus*) **nigrovittatus** HORSF.

(The Black-striped Squirrel — De Zwartgestreepte Eekhoorn)

Sciurus nigrovittatus

HORSFIELD, Zool. Res. 1824, s.p. MÜLLER, Verh. Zoogd. 1839, p. 34. MÜLLER en SCHLEGEL op.c. 1839—44, pp. 86, 95. GRAY, Voy. Samarang, Zool. 1849, p. 24. CAT. Mus. E. I. Comp. 1851, p. 152. JENTINK, Cat. Syst. XII, 1888, p. 28. KONINGSBERGER, Med. Plantent. 54, 1902, p. 52. THOMAS and WROUGHTON, P.Z.S. 1909, p. 388. BREHM, Tierl. Säuget. II 1914, p. 535. BARTELS, Tectona X, 1917, p. 264. v. HEURN, Ind. Gids 49 II, 1927, p. 706. SODY, N.T.N.I. 87, 1927, p. 200.

Sciurus griseiventer

I. GEOFFROY, Mag. Zool. 1832.

Sciurus notatus (part.)

TJEENK WILLINK, N.T.N.I. 65, 1905, p. 240. TROUESSART, Cat. 1897, p. 416.

Sciurus *(Heterosciurus)* **nigrovittatus**

TROUESSART, Cat. Suppl. 1904, p. 314.

Callosciurus nigrovittatus

ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 222.

Vernacular names.

This species is called by the same native name as the foregoing one, occasionally it is distinguished as "bajing utan".

Nomenclatural.

It is a noteworthy fact that MÜLLER in the first paper of the „Verhandelingen" had apparently a clear notion of the distinctness of the two species *nigrovittatus* and *notatus* (*plantani*), telling us that both are equally common in Java and Sumatra. But in a next paper of the same work by the said author and SCHLEGEL the two species were amalgamated, and this opinion has been accepted by almost all older authors. Now the specific distinctness of the two forms is well established and confirmed by the study of the penis bone.

Description.

Upper surface as in *notatus* but less bright, light olive-brown or buffy brown; hands and feet, especially the latter, less greyish not much contrasting with the colour of the body. The muzzle, sides of head and neck, chin, and the eyerings more or less ochraceous tawny. Pale lateral stripe hardly marked off from sides of body; dark lateral stripe broad and black. Underparts and limbs interiorly dark greyish, the throat with buffy suffusion, which continues sometimes on the breast as an indistinct median stripe.

Hairs on middle of black with 2 or 3 light bands, which are also found with the dark woolly hairs. The lower fur consists of straight black hairs and grey woolly hairs, both ending in white tips.

Tail paler in colour than in *notatus*, the black annuli more regular and more conspicuous; the tip usually black.

Females with six mammae, two inguinal and one pectoral pair. The mammae occasionally surrounded by very conspicuous broad rings of light sometimes nearly white hairs.

Varieties.

We have in our collection two specimens, one from Batavia the other from Buitenzorg, having the lower surface and inside of limbs pure white; the pale and black lateral stripes have disappeared. Possibly we are dealing here with the form described by JENTINK as *diardi* (see p. 465).

In the Botanical Gardens, Buitenzorg, often specimens are met with, occurring together with normally coloured individuals, which are very pale, the upper surface including the limbs being tawny olive to light clay colour. In the palest example the tail is cinnamon-buff and the dark annuli are almost obsolete. The underparts are lighter grey and sullied with buffy.

Measurements.

Measurements, average and maximum (in mm): total length, 355 (390); head & body, 190 (200); tail, 165 (190); ear, 16 (18); hindfoot, 42 (44).

Measurements

	W. Java				N. Kambangan				E. Java			
Mus. Btzg. No.	♂ 2058	♂ 2063	♀ 2055	♀ 2061	♂ 2072	♂ 2073	♀ 2074	♀ 2090	♂ 645	♂ 646	♀ 644	♀ 648
total length	390	352	350	359	355	360	340	360	343	343	302	350
head & body	200	188	184	197	200	185	187	190	178	185	162	191
tail	190	164	166	162	155	175	153	170	165	158	140	159
ear	18	17	18	16	16	15	14	14	16	16	15	16
hindfoot	40	44	38	42	44	43	40	40	40	43	38	42

Skull measurements

Mus. Btzg. No.	2058	2063	2055	2061	2072	2073	2074	2090	645	646	644	648
total length	46.4	44.6	43.6	45.3	47.0	45.0	44.6	44.8	44.6	44.7	40.0	44.0
bas. length	40.0	38.0	37.8	39.1	39.7	39.1	38.7	38.7	39.3	38.9	34.6	38.2
zyg. breadth	28.5	27.7	26.3	27.9	29.2	27.6	28.7	28.0	26.7	28.4	24.6	27.5
cran. width	21.5	21.3	20.6	21.0	22.2	20.9	21.5	21.3	21.5	22.1	20.8	21.6
interorb. br.	16.4	16.8	17.3	17.8	18.7	17.2	16.5	16.6	16.1	18.2	13.7	16 6
postorb. br.	16.9	17.2	16.3	17.0	17.8	16.5	16.7	17.0	17.5	17.1	16.5	17 5
med. l. nas.	14.1	13.5	13.2	13.3	13.2	13 8	12.1	12.3	12.5	—	12.3	—
gr. br. c. nas.	6.8	6.1	6.2	6.9	6.8	6.2	6.8	6.4	6.0	6.5	5.8	6.3
pal. length	19.6	18.4	18.4	19.1	19.3	19.7	18.6	18.1	19.0	19.0	17.5	18.4
l. inc. for.	3.2	3.2	3.2	3.1	3.2	2.9	2.9	3.0	3.0	2.9	3.0	3.1
upper mol. ser.	8.8	8.4	8.6	8.7	9.0	9.0	8.9	9.0	8.9	9.2	8.5	8.7
diastema i-p	11.0	11.0	10.1	11.0	11.2	10.2	9.8	10.0	10.5	10.3	9.7	10.9
lower mol. ser.	8.7	8.0	8,2	8.2	8,1	8.3	8.5	8.4	8.6	8.6	8.3	8.2

Skull.

The skull of *nigrovittatus* is not so large as that of *notatus* but proportionally broader, the zygomatic breadth being 72% of the basilar length; palatilar length shorter; length of molar series less.

Measurements, average and maximum (in mm): total length, 45 (47); basilar length, 39 (40); zygomatic breadth, 28 (29.2); cranial width, 21.5 (22.2); least interorbital breadth, 17 (18.7); least postorbital breadth, 17 (17.8); median length of nasals, 13 (14.1); greatest breadth combined nasals, 6.5 (6.9); palatilar length, 19 (19.7); length incisive foramen, 3 (3.2); length upper molar series, 8.8 (9.2); diastema i-p, 10.6 (11.2); length lower molar series, 8.4 (8.7).

Penis bone (fig. 7).

The baculum in this species is a rather slender bone bayonet-like in form; the hollowed basal end very slightly expanded, the apex turned upwards. Length 20—21.6 mm.

Habits.

The black-striped squirrel has about the same mode of life as the *notatus*; in cultivated districts they seldom occur together but in more forested hilly regions the two species may be found on the same spot. Unlike *notatus* its range extends to the highest mountain tops.

Distribution.

Malay Peninsula and the Greater Sunda Islands.

Subspecific characters.

Examples from the Idjen Massif, East Java, have been separated from the true *nigrovittatus* as *S. n. besuki* on account of the underparts being more or less sullied with buff. But we have got specimens from Blawan, Idjen 950 m, which, four out of five, are practically without this suffusion and hardly separable from typical *nigrovittatus* from West Java. Also the differential characters given for *besuki* are not specific to the mountain form, as examples from Mt. Tjiremai, 700-2500 m, and Mt. Sindoro, 2000 m, have the lower fur clear greyish. Moreover, an ochraceous suffusion should sooner be expected in specimens from arid localities than from more humid mountain regions. So for the moment we cannot allow subspecific value to this buffy suffusion.

We have not seen the form *madsoedi* SODY so we cannot offer an opinion but it seems not very probable that we are dealing here with a truly geographical race but rather with a dark variety.

Pending further investigations we think it better to accept for the present only one Java subspecies.

Sciurus (*Callosciurus*) ***nigrovittatus nigrovittatus*** (HORSF.).

Callosciurus nigrovittatus nigrovittatus

ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 222. SODY, N.T.N.I. 89, 1929, p. 163.

Sciurus nigrovittatus nigrovittatus

DAMMERMAN, Tjibodas 1929, p. 22; Treubia XI, 1929, p. 35.

Sciurus nigrovittatus besuki
KLOSS, J.F.M.S. Mus. X, 1921, p. 231. DAMMERMAN, Treubia XI, 1929, p. 35.
Callosciurus nigrovittatus besuki
SODY, N.T.N.I. 89, 1929, p. 163.
Callosciurus nigrovittatus madsoedi
SODY, N.T.N.I. 89, 1929, p. 163; 90, 1930, p. 261.

Description.

Upper fur light olive-brown or buffy brown; cheeks, sides of neck, and chin washed with ochraceous or tawny. Lower surface and inside of limbs dark greyish, this colour sometimes sullied with tawny.

Distribution.

Java and South Sumatra. Localities. W. Java: Oedjoengteboe and Tjiomas, 300 m (Bantam); Batavia; Buitenzorg; Wijnkoops Bay; Mt. Gede, 1200—2400 m; Mt. Tjiremai, 700—2500 m; Garoet, 700 m; Kalipoetjang. C. Java: Tjilatjap; Noesa Kambangan; Karangbolang; Mt. Sindoro, 2000 m; Mt. Moeria, 500 m. E. Java: Idjen Massif, 500—1850 m.

Sciurus diardi JENT.

Sciurus diardi
JENTINK, N. L. M. I, 1879, p. 38; V, 1883, p. 125; Cat. ost. 1887, p. 189; Cat. syst. XII, 1888, p. 21. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 241. V. BALEN, Zoogd. 1914, p. 298. DAMMERMAN, Treubia XI, 1929, pp. 4, 35. SODY, N.T.N.I. 89, 1929, p. 163; 90, 1930, p. 277.
Sciurus (Heterosciurus) diardi
TROUESSART, Cat. 1897, p. 418; Suppl. 1904, p. 315.

Description.

As we have no specimens of this form at hand JENTINK's original description is quoted here:

"*Sciurus Diardii*, Temminck in litt. Fur above rusty coloured, the underparts of the body being yellowish white. Hairs of the head, back, sides of the body and outside of legs black near the base, higher on rusty, with a very small black tip. Several entirely black hairs are intermixed with these.

The hairs of the tail are very long rusty, with a subterminal black ring and black tip. Hairs of chin, throat, chest, belly and inside of legs entirely yellowish white.

Whiskers quite long, black. Ears short, rounded, with scarce hairs. Cutting-teeth yellow. The end of the tail is wanting.

Measurements of the only specimen we received, which is an adult: head and body, 230; ear, 14; hind foot, 44; length of nasalia, 13; length upper molar series, 9; distance between incisor and first upper molar, 11; idem and first lower molar, 6 mm.

Hab.: Nusa Kambangan (e coll. Blüme)."

Remarks.

This description of *diardi* is fairly well apposite to that of the white-bellied variety of *nigrovittatus* given on p. 463. Also the measurements, taking into account that JENTINK's figures are those from a stuffed specimen, quite agree with those of *nigrovittatus*. Moreover, the black-striped squirrel is very common on Nusa Kambangan, the island off the south coast of Central Java, so it need not be a matter of surprise if the above-mentioned variety should also occur there.

However, the matter cannot be settled until an examination of the type specimen in the Leiden Museum has been made.

Genus **LARISCUS,** THOMAS et WROUGHTON (1909)

The only representative in Java is:

Lariscus insignis (F. CUV.)

(The Striped Ground-squirrel — De Gestreepte Grondeekhoorn).

Sciurus insignis
F. CUVIER, Mamm. 1821, pl. 233. HORSFIELD, Zool. Res. 1824, s.p., fig. MÜLLER en SCHLEGEL, Verh. Zoogd. 1839—44, pp. 87, 99. GRAY. Voy. Samarang Zool. 1849, p. 25. CAT. Mus. E. I. Comp. 1851, p. 151. JENTINK, N.L.M. V, 1883, p. 136; Cat. ost. 1887, p. 193; Cat. syst. XII, 1888, p. 29; Weber's Zool. Erg. I, 1890, p. 117. WEBER, op.c., p. 95. KONINGSBERGER, Med. Plantent. 54, 1902, p. 50; Java 1915, p. 497. BARTELS, Tectona X, 1917, p. 264.
Xerus (Eoxerus) insignis
TROUESSART, Cat. 1897, p. 409.
Funambulus *(Rhinosciurus)* **insignis**
TROUESSART, Cat. Suppl. 1904, p. 306.
Rhinosciurus insignis
TJEENK WILLINK, N.T.N.I. 65, 1905, p. 235. v. BALEN, Zoogd. 1914, p. 283. BREHM, Tierl. Säuget. II, 1914, p. 351. ENCYCL. Ned. Ind. I, 1917, p. 653.
Laria insignis
THOMAS and WROUGHTON, Abstr. P.Z.S. 1909, p. 19.
Lariscus insignis
ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 233.

Vernacular names.
Sund.: bajing tanah; Javan.: bokol.

Description.
Colour of upperparts variegated greyish brown, shoulders, flanks and outside of hindlegs more bay; on the back three black longitudinal stripes of 4—6 mm in breadth, on the shoulders and the rump fading into the colour of the upper fur. Straight hairs on middle of back entirely black or shorter ones with an ochraceous to reddish brown subterminal band; dark grey woolly hairs also with a yellow band near the end. Sides of the head of a lighter hue than the general colour of upper surface. Inside of the ear and outer border with short black hairs with ochraceous annuli, outside blackish. The long black whiskers reach beyond the opening of the ear. Hand and feet more greyish.

Under surface whitish, washed with apricot buff, more markedly on the throat. Hairs on belly white with buffy ends; woolly hairs whitish with dark bases. Inside of forelegs more greyish, of hindlegs more orange.

The bushy tail blackish brown with long hairs, the latter black with one to three ochraceous rings on the basal half, the distal end whitish with dark tip; the tip of the tail with more yellow-ending hairs.

Female with three pairs of mammae situated at about equal distance from each other, the pectoral pair less developed.

Measurements.

Measurements, average and maximum (in mm): total length, 283 (300); head & body, 181 (194); tail, 102 (119); ear, 17.5 (19); hindfoot, 44 (46).

Measurements

	W. Java							E. Java		
Mus. Btzg. No.	♂ 2313	♂ 2689	♂ 2690	♂ 2691	♀ 2310	♀ 2311	♀ 2312	♂ 641	♀ 640	♀ 642
total length	296	283	293	280	280	271	274	281	300	275
head & body	183	180	185	194	184	165	190	165	181	183
tail	113	103	108	86	96	106	84	116	119	92
ear	19	17	16	18	17	17	17	17	18	18
hindfoot	45	46	46	45	40	44	46	42	44	44

Skull measurements

Mus. Btzg. No.	2313	2689	2690	2691	2310	2311	2312	641	640	642
total length	50.6	47.7	47.2	49.6	49.0	48.3	49.2	44.7	48.6	45.4
bas. length	43.3	41.6	42.2	42.9	43.1	42.7	43.3	38.1	42.6	40.2
zyg. breadth	27.7	28.1	28.1	29.0	28.2	27.2	28.9	26.9	29.0	26.8
cran. width	20.7	21.3	21.3	21.7	20.3	19.8	21.1	20.6	20.8	19.9
interorb. br.	13.0	13.3	13.3	13.5	13.3	12.8	13.8	12.2	—	12.0
postorb. br.	15.1	15.7	16.2	15.8	15.3	16.0	16.1	15.6	15.7	14.8
med. l. nas.	16.5	15.1	14.8	15.6	16.3	16.3	16.4	14.5	15.9	14.6
gr. br. c. nas.	6.1	6.0	6.1	6.2	5.7	6.0	6.1	5.1	6.2	5.6
pal. length	22.9	22.7	22.1	22.8	22.3	21.6	22.6	19.7	21.0	20.4
l. inc. for.	—	3.8	3.8	3.9	3.8	3.6	3.9	3.2	3.6	3.5
upper mol. ser.	9.8	9.9	9.3	9.7	9.5	9.7	9.6	9.1	9.0	9.2
diastema i-p	13.2	12.9	13.0	13.5	13.2	12.8	13.2	11.4	12.4	11.7
lower mol. ser.	9.6	9.3	9.0	9.5	9.2	9.2	9.4	9.2	8.8	9.0

Skull.

Skull elongated especially the muzzle; postorbital processes very short.

Measurements, average and maximum (in mm): total length, 48 (50.6); basilar length, 42 (43.3); zygomatic breadth, 28 (29); cranial width, 20.7 (21.7); least interorbital breadth, 13 (13.8); least postorbital breadth, 15.6 (16.2); median length of nasals, 15.5 (16.5); greatest breadth combined nasals, 6 (6.2); palatilar length, 22 (22.9); length incisive foramen, 3.7 (3.9); length upper molar series, 9.5 (9.9); diastema i-p, 12.7 (13.5); length lower molar series, 9.2 (9.6).

Penis bone (fig. 8).

The os penis of this species is of the *Tomeutes*-like type, being short and thick-set and the distal half sharply upturned. Basal part hollowed, the anterior portion flattened above. The blade much developed, the anterior part with short expanded base closely applied to the upturned part of the shaft, posteriorly reaching until the base of the main bone. Length 10—10.4 mm; basal width 3.2—3.5 mm.

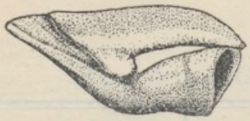

Fig. 8. Penis bone of *Lariscus insignis*, side view; × 3.

Habits.

This ground-squirrel is found in the forests up to the summit of the highest mountains; its mode of life is more terrestrial, the food consisting of fallen fruits and those of low-growing shrubs, but the diet is not entirely frugivorous, insects being also taken. The noise emitted is a shrill chirp, reminding the cry of a bird.

Distribution.

Malay Peninsula and the Greater Sunda Islands.

Subspecific characters.

The Java form has been set apart as *L. i. javanus* being somewhat larger and darker than the other races. The palatilar length is said by THOMAS and WROUGHTON to be 24 mm as against 19—22 mm in typical *insignis*, but the greatest length measured in our series is only 22.9 mm.

Specimens from East-Java mountains were separated as *vulcanus*. In this form the majority of the hairs of the tail has buff terminal ends; the underside is less buffy, more greyish white with ochraceous suffusion and the inside of the hindlegs not orange. This buff discoloration of the tail is, however, not a subspecific distinctness of all East-Java examples, neither characteristic for mountain specimens. Thus a specimen from Blawan, Idjen Massif 950 m, has the tail hairs tipped with white, whereas an example from the lowlands of Cheribon, West Java, has nearly no white-tipped hairs in the tail. Another specimen from Mt. Tjiremai, taken at 2000 m, has the tail yellowish but its lower fur is intermediate between *javanus* and *vulcanus*.

So for the time being we cannot yet confine the form *vulcanus* to a special climatic or geographical area, and I think we better accept presently only one subspecies for Java.

Lariscus insignis javanus THOS. et WROUGHTON.

Laria insignis javana

THOMAS and WROUGHTON, Abstr. P.Z.S. 1909, p. 19.

Lariscus insignis javanus

THOMAS and WROUGHTON, P.Z.S. 1909, p. 389. ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 234. DAMMERMAN, Tjibodas 1929, p. 22; Treubia XI, 1929, p. 36. SODY, N.T.N.I. 89, 1929, p. 162.

Lariscus niobe vulcanus
KLOSS, J.F.M.S. Mus. X, 1921, p. 233.
Lariscus insignis vulcanus
DAMMERMAN, Treubia XI, 1929, p. 36. SODY, N.T.N.I. 89, 1929, p. 162.

Description.

For description see above.

Distribution.

Java. Localities. W. Java: Oedjoengteboe, 300 m (Bantam); Mt. Salak near Buitenzorg; Wijnkoops Bay; Tjibodas, 1400 m; Tjibeber, 1080 m; Cheribon; Mt. Tjiremai, 700—2500 m. C. Java: Noesa Kambangan. E. Java: Idjen Massif, 500—1850 m.

Genus **NANNOSCIURUS**, TROUESSART (1880).

Java is occupied by only one species and subspecies.

Nannosciurus melanotis melanotis MÜLL. et SCHL.

(The Black-eared Pigmy squirrel — De Zwartoor-dwergeekhoorn).

Sciurus soricinus
WATERHOUSE, Cat. Mamm. 1838, p. 46 (nomen nudum). JENTINK, N.L.M. V, 1883, p. 130; Cat. ost. 1887, p. 191; Cat. syst. XII, 1888, p. 25. VETH, Java III, 1912, p. 293.
Sciurus melanotis
MÜLLER, Verh. Zoogd. 1839, p. 35. MÜLLER en SCHLEGEL, op.c. 1839-44, pp. 87, 98, pl. 14, fig. 4—7. GRAY, Voy. Samarang Zool. 1849, p. 25. JUNGHUHN, Java I, 1853, p. 465. KONINGSBERGER, Med. Plantent. 54, 1902, p. 51; Java 1915, p. 542. BARTELS, Tectona X, 1917, p. 264.
Nannosciurus melanotis
TROUESSART, Cat. 1897, p. 446; Suppl. 1904, p. 345. TJEENK WILLINK, N.T.N.I. 65, 1905, p. 249. LYON, Proc. Biol. Soc. Wash. XIX, 1906, p. 51. THOMAS and WROUGHTON, P.Z.S. 1909, p. 389. V. BALEN, Zoogd. 1914, p. 302. ENCYCL. Ned. Ind. I, 1917, p. 649.
Nannosciurus melanotis melanotis
ROBINSON and KLOSS, Rec. Ind. Mus. XV, 1918, p. 248. DAMMERMAN, Treubia XI, 1929, p. 36. SODY, N.T.N.I. 89, 1929, p. 163.

Description.

Upper fur greyish snuff-brown [1]) composed of blackish hairs with two yellowish rings and entirely black hairs, and undulating woolly hairs dark with a broad ochraceous subterminal band. Muzzle ochraceous; chin whitish; the neck between the ears with a broad band of a somewhat lighter tinge than the back. Head with black lines extending from the middle of the nose to the eyes, running above the ochraceous buff eyerings and ending at the ears. Beneath each black line a broader whitish stripe running from the nose below

[1]) The colour of the upper surface has been described by LYON as red-brown, but probably this is due to his specimens having been in a preserving fluid. In describing delicates tinges, especially for subspecific discrimination, one should never use specimens having been preserved in spirit or any other fluid, as this may alter the colour, the discolouration looking often quite natural and therefore being very deceptive.

the eye and the ear and ending a short distance behind the latter. On the muzzle those stripes sullied with buff and below fringed by a black streak diffusing on the sides of the head. Hands and feet above of a somewhat lighter hue than the back. Ears on the inside and at the anterior border with short yellowish hairs; the outside with longer black hairs. A tuft of long black hairs behind the ear sharply contrasting with the white stripe running underneath. The very long black whiskers reach to the axillae.

Underparts greyish slightly tinged with buff, more markedly on the breast; straight hairs blackish tipped with light yellowish; woolly hairs dark grey.

Tail variegated brownish black, the long black hairs with a brownish ring near the base and a larger one in the middle part, the distal end with a broad whitish ring, the tip dark again.

Measurements.

Measurements of three specimens (in mm): total length, 145, 147, 150; head & body, 80, 82, 81; tail, 65, 65, 69; ear, 10, 9, 11; hindfeet, 24, 23, 24.

Skull.

The skull is very broad especially the frontal region, zygomatic breadth more than 80% of the basilar length. Maxillar root of zygoma a thin vertical septum facing frontally. Postorbital processes directed backwards, the posterior tip lying above the squamosal root of the zygomatic arch.

Measurements of two skulls (in mm): total length, 24.5, 24.3; basilar length, 19.8, —; zygomatic breadth, 16.1, 17.3; cranial width, 13.4, 14.3; least interorbital breadth, 9.6, 10.4; median length of nasals, 8.3, 8.0; greatest breadth combined nasals, 3.2, 3.4; palatilar length, 10.0, 10.3; length incisive foramen, 1.2, 1.2; length upper molar series, 4.1, 4.0; diastema i-p, 4.9, 5.1; length lower molar series, 3.9, 3.8.

Distribution.

The range of the species covers the Greater Sunda Islands, the typical *melanotis* being confined to Java.

Localities. W. Java: Buitenzorg; Mt. Gede, 1000 m; Djampang.

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